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Movement Control: Enhancing Contingency Resupply

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Abstract

This paper addresses one aspect of logistics support, movement control of resupply cargo, in the belief that materiel distribution in contingencies must be tied to combat requirements. This concept involves the unified command in resupply of combat forces through movement decisions based on the availability of transportation resources, port handling/processing capability, and relative urgency of need. By prioritizing shipments competing for limited transportation capability, this movement control system gives the unified commander a means to connect resupply flow with combat objectives.

A PACOM movement control system for contingency resupply is proposed, which would use augmenters identified and trained in advance. Since there would be no full-time commitment of personnel nor money, the system would be a highly cost-effective means of maintaining management capability which, while not needed in peacetime, is absolutely necessary in a contingency.

Movement Control of Resupply in the Vietnam Era

Movement control involves regulation of materiel flow based on total transportation capability and priority of multi-service need (1:10). Contingency situations almost always demand movement control, since, when requirements exceed transportation capability, decisions must be made about what goes first. This was highlighted during the U.S. experience in Vietnam, when painfully developed systems of the 1965-1970 period arose from chaotic conditions.

The movement control system provides *the* vital link between shippers, the Defense Transportation System (DTS), and the user (3:145). Lack of it during early Vietnam years caused port congestion at both ends of the transportation system, resulting in delayed receipt of critical materiel by combat organizations (1:11). Although each military service had systems and procedures to manage cargo flow in coordination with transportation operating agencies (TOAs), focus was strictly unilateral (3:32). Inter-service relations became increasingly competitive as the battle for scarce transportation heightened. The joint perspective in modern warfare was overlooked, which often resulted in routine cargo of one service moving ahead of extremely urgent shipments of another, to the detriment of joint battlefield objectives.

This situation was (and would be today) complicated by the fact that transport assets could be called on in several different ways. No agency had an overall view of the state of the entire transport system and shipments moving within it. A brief treatment of this subject is warranted because it underlies the basic focus of this paper. That is, joint movement control at the unified command level is essential to ensure resupply supports the broadest military goals and objectives, and that unified logistical decisions must link to practical operation of the DTS (2:163).

First, each service and defense agency can separately forecast routine resupply/replacement movement requirements to TOAs directly (3:32). TOAs then program scheduled flights/voyages, with timing and type of capability tailored to meet forecasted demand. Secondly, each service and defense agency can request capability to meet one-time or unanticipated requirements. These may be self-generated or by direction of higher authority. What normally transpires is that, because movement in the regularly scheduled system is most economical, the services and defense agencies try to push as much unplanned traffic into the system as TOAs will accept. In a contingency, this quickly results in saturation and port backlogs, which the TOAs tolerate up to a point. Large port backlogs are useful because, the greater the array of cargo awaiting movement, the better the airframe/vessel utilization and, therefore, productivity. This is qualified by the phrase "up to a point," since, after a certain backlog level is reached, management becomes quite taxing. Priority conflicts arise and shipper pressures grow due to delays beyond normal movement timing parameters. The Department of Defense (DOD) has provided TOAs with a simple transportation priority system for adjudication between competing shipments, but these priorities only reflect the urgency of need assigned by the organization "pulling" or "pushing" the shipment. There is no way to indicate one transport user's priority relative to other competitors for transportation and the unified command's combat objectives.

The bottom line in peacetime is, when backlogs become unmanageable, TOAs simply apply additional capability to alleviate them. In a contingency, this will not work because competing demands for deployment transportation, support for strategic weapons systems, and commitments to U.S. forces in other forward locations all clamor for limited capability. To complicate things further, inter- and intra-theater movement requirements vie for support from the same transportation assets and port handling capability. Without a single agency responsible to monitor the dynamic capability-versus-requirements arena on behalf of the entire combat theater, the DTS can quickly become bogged down and, in terms of contingency resupply support needs, be inefficiently employed.

The Build-up

When the introduction of ground forces began in 1965, there was no overall control of movement flow, other than that exercised by the National Command Authority (NCA), in determining the exact mix of deploying forces. Each service managed individual logistics support separately in accordance with defense policy (4:2 and 6). On-the-shelf plans were of little value, since they were not relatable to the situation as it developed (1:5). Even though a number of studies done early in 1965 predicted some of the coming difficulties, no corrective action was taken (1:5).

By late 1965, events had gone out of control, with primary emphasis on combat force deployment issues. The Joint

Logistics Review Board (JLRB) Report states that:

> Although the procedures of the Joint Chiefs of Staff for submission of movement requirements [by the services] distinguished between those in support of routine requirements and those in support of contingency plans, they did not provide for a major military operation based on a series of incremental deployment decisions without implementation of an approved contingency plan (3:42).

In other words, force deployment decisions were ad hoc rather than controlled by a master plan. The JLRB Report further states that "The deployment of U.S. combat forces placed formidable demands on military logisticians" (1:4). These demands resulted from two conditions, which were:

(1) U.S. forces committed without sufficient lead time for logistics preparation and planning.

(2) Force package composition continually changed, dictating frequent adjustments to logistics support and leaving little opportunity for short- or long-range supply build-up (3:43).

At one point in the fall of 1965, 125 cargo vessels awaited berthing at ports which could only accommodate 25-30 ships at a time. Even more vessels were backed up in the Philippines and Okinawa (5:D, p. 3). Symptoms of this sort persisted. For example, between July 1966 and June 1967, ship delay time awaiting offloading in SVN ports totalled 11,240 days (3:61).

The situation at CONUS ports was no better. As of mid-1966, the Military Traffic Management and Terminal Service (MTMTS) reported 186,114 measurement tons (M/T) of backlogged, unbooked cargo on the West Coast destined for SVN (3:62). This was caused largely by imbalances between port capacity, port handling, and movement capability; it was further exacerbated by the poor interface among shippers and consignees (3:145).

In fact, much of the materiel being moved had little or no relation to actual resupply requirements. First, push-type supply systems were used that shipped materiel according to pre-planned consumption rates, not actual use. Second, there was little or no supply discipline, resulting in duplicate requisitions, excessive quantities ordered, and abuse of movement priority systems. Finally, plans, programs, and combat operations changed rapidly, with little or no adjustment in supply (1:20).

Since the total transportation system was saturated, an increase in resupply cargo flow simply was not possible, even if additional air and sealift assets had been available or port handling capability increased. This combination of a saturated transportation system, with neither additional lift resources nor port handling capability available, finally forced the issue. By late 1966, a theater-wide movement control system had been pieced together and was gearing up.

The Theater Movement Control Organization

Movement control began to develop, between May 1965 and August 1966, from the bottom up. At the beginning of the Vietnam Conflict, CINCPAC's West Pac Transportation Office (WTO), Tachikawa Air Base, Japan, was the only minor agency performing a movement control function in the Pacific theater. The WTO was created in 1961 to exercise CINCPAC operational command of theater-assigned tactical airlift forces, consisting of five C–130 squadrons (6:5). Although flown by the Air Force, this fleet operated on a common user basis. That is, all services in the theater competed on an equal footing for capability, with allocation determined by relative mission priority.

The WTO's role was expanded in May 1965 (6:11). Encountering increasing problems with determination of intra-theater sealift priorities, the Commander, Military Sea Transportation Service (MSTS), Far East (FE), requested CINCPAC assistance. The WTO became the unified commander's agent for sealift allocation and movement priority arbitration, with MSTS retaining command of sealift assets.

The next step in evolution of the movement control system came in September 1965, when COMUSMACV established a joint traffic management agency (TMA) for control of all transport activity in South Vietnam (6:11). This action was at least partially in response to the growing congestion at in-country sea and aerial ports. The TMA provided centralized, unified control of in-country transportation and was a single point-of-contact for out-of-country agencies.

There was further improvement in coordination and control of movement activity in November 1965. CINCPAC directed establishment of a WTO Saigon branch, with both airlift and sealift responsibility (6:14). It was a needed link between the TMA and the CINCPAC Staff.

The next incremental development, perhaps the most significant one, occurred in January 1966, when CINCPAC formally chartered the Pacific Command Movements Priority Agency (PAMPA). This body was directed to:

> . . . insure that PACOM-bound sea and air cargo is most effectively moved in accordance with recipients' need for the material, the discharge and clearance capabilities of receiving terminals, and the availability of sealift and airlift resources. Particular emphasis will be placed on traffic for Vietnam (7:1).

PAMPA was located at Oakland Army Base, California, adjacent to both MSTS and MTMTS regional headquarters. Its initial efforts were crude, since control mechanisms were worked out as the new organization encountered problems. Once PAMPA gained credibility with service shipping activities and MACV, it was able to effectively plan and control materiel flow to support both South Vietnam combat operations and other theater users. Since approximately 81% of all sealift and 74% of all airlift to Vietnam originated from the CONUS, establishment of the PAMPA as a filter for CONUS-originating movement was the single most important element of the movement control system's success (3:A-17, A-18, and A-25).

The final part of the PACOM movement control network was created in August 1966 with establishment of a theater Joint Transportation Board (JTB). The JTB was a policy-making body, charged with optimum utilization of all PACOM transportation resources in meeting CINCPAC's objectives (3:149). It also acted in an arbitration role, resolving differences that could not be settled between users and movement control agents. The JTB was composed of CINCPAC's Director for Logistics and service component senior logisticians.

Current Defense Logistics Issues

Lately, shortfalls in U.S. military ability to project and maintain combat forces have received much attention. The former Chairman of the Joint Chiefs of Staff (JCS), General David C. Jones, stated that ". . . we have a great deal of work to do in order to update our near term capability to mobilize, deploy and sustain our combat forces" (8:vi). The main focus,

however, has been on deployment of forces, as evidenced by recent creation of the Rapid Deployment Joint Task Force and the Joint Deployment Agency (9:28).

In addition, the insufficiency of air and sealift assets to support deployment needs has been clearly identified in Organization of the JCS studies (8:76), but solutions tend to be hardware oriented. Some examples are the procurement of roll-on roll-off (RO-RO) shipping to preposition equipment and consumable stocks afloat, and the drive to acquire more aircraft for forward delivery of outsized cargo. Several enhancement/improvement programs (C–141 stretch program) focus on existing assets.

While these initiatives will partially reduce DTS shortfalls for support of operational plans, some programmed improvements and new systems will not be available for many years (9:iv). Thus, the problem of transport shortages will probably persist for at least the remainder of this decade.

Supply factors complicate the situation. For one, the JCS stated that significant deficiencies in ammunition, repair parts, and equipment exist throughout the services (8:79). Also, General Bryce Poe II, former Commander, Air Force Logistics Command, gave a clear indication of the magnitude of Air Force deficiencies in the vital repair parts area. In a speech to the Air Force Association Airpower Symposium in March 1980, he commented on chronic underfunding of war readiness spares kits, averaging only 44% of requirements from FY77 to FY81 (10:24). He further noted that sustaining spares capability simply does not exist. The net result is numerous repair requirements chasing relatively few spare parts. In the same speech, General Poe noted that regardless of funding increases, there will be no short-term improvement because production lead times are as much as two or three years for some components (10:25).

In summary, then, transportation shortfalls will be exacerbated by supply deficiencies and a more demanding combat environment. Hardware improvements are planned, but will only partially resolve these problems over the next five to ten years. Also, port reception capability remains a potential limiting condition, regardless of the aircraft and ships available. The conundrum facing unified commanders, who play only a limited role in peacetime logistics preparations, is how to plan for the conduct of combat operations when many inadequacies exist.

Major General John D. Bruen, Commander of the Military Traffic Management Command, has said that the challenge of the 1980s will be to achieve a total DTS perspective by integrating all mobility system elements (12:4). He emphasized that *cooperative* effort and *cooperative* concessions will result in *cooperative* benefits. While this is certainly desirable and would be most effective on a DOD-wide basis, efforts to centralize DOD transportation management have consistently failed since 1944 (11:71-82).

Far less tangible issues than those discussed so far may also affect contingency resupply. The multi-dimensional and dynamic nature of the DTS, plus how it interfaces with overall contingency operations, exposes the system to a wide range of unpredictable factors which could result in serious problems. For example, attrition of transportation assets through enemy action against inter-theater lines of communication is something this nation has not faced since World War II. Will our already inadequate capability be further reduced? If so, by what quantity and when? How do transportation feasibility analyses of plans take this possibility into consideration? A related question lies in the potential for enemy sabotage or attack on transportation support facilities. How rapidly could the DTS react to and overcome such setbacks? Also, how might overflight, landing, and transit rights affect the efficient flow of transportation?

Optimists might point to the "bottom line" result of DTS support for U.S. forces in Vietnam. In fact, the JLRB Report stated, "Actual events have proved that combat forces were adequately supported . . ." (1:5). If success was possible despite the many obstacles encountered, why cannot it happen again? The answer depends on our willingness to accept risk. The conditions prevailing during the Vietnam era were unique and can be characterized as permissive and forgiving.

So far, emphasis has been placed on the negative aspects of current issues in the capability and readiness areas. Certainly these conditions are appreciated and are being slowly improved, but the central issue persists. What can be done immediately to compensate for our weaknesses? Considering the lessons of Vietnam and the present situation, PACOM, or any other unified command, has only one option that is both immediately available and does not disrupt normal DTS-customer relationships—the rapid and firm imposition of unified movement control in a contingency. This offers the unified commander a means to work around deficiencies. The full exercise of unified authority permits movement control of that portion of the DTS which supports contingency operations. The extent of movement control can be tailored to the contingency at hand.

During the Vietnam era, the PACOM movement control system used management by exception to allocate and adjudicate. It did not preempt the systems and procedures by which the services normally interface with the DTS. It used the information generated by normal DTS operations to highlight and resolve problems, mainly through coordination and communication.

Of the JLRB's 265 recommendations, only four were singled out in the Report's Summary because they were of ". . . overriding importance or because they represent significant innovations" (1:74). The need for movement control organizations, systems, and procedures at an early point in the contingency was among the four "key" recommendations.

Rear Admiral Henry E. Eccles, USN (Ret), one of the few published writers who has addressed the subject of movement control, stated that it is an inherent part of command control and flexibility in the logistics area (2:123). He also noted that it links high-level logistics decisions and actual DTS operations (2:163).

The Unified Command Role in Defense Transportation System Management

Even a cursory examination of the organizations, systems, and procedures that command, control, and support today's U.S. military combat forces will quickly convince the observer of their complexity. Truly, the exercise of command authority has grown more complex in this era, due principally to the increasing role of technology. Thus, the need for integration of all elements of military action has become more essential (2:16). The responsible commander must use available forces in the most appropriate manner and exercise comprehensive direction to attain assigned objectives (2:25).

The National Security Act of 1947 codified lessons learned about the effectiveness of the unified approach in World War II. In the Act, Congress established unified commands to ". . . provide for the unified strategic direction of the combatant forces, for their operation under unified command, and for their integration into an efficient team of land, naval, and air forces . . ." (13:318).

Formal Authority

Joint Chiefs of Staff Publication No. 2 (JCS Pub 2), "Unified Action Armed Forces," describes ". . . principles, doctrines and functions governing the activities and performance . . . of two or more U.S. military Services when acting together" (14:3). It also expounds on several concepts which govern joint activity within the DOD.

The principle of maximum integration is particularly critical in DTS operations. Since the services share limited transport capability, the integration of their movement requirements is essential to meet overall military objectives. The JLRB recognized this when it called for active unified command involvement ". . .in the multi-service aspects of transportation and movement control. . ." (1:41). In other words, the interests of any one service must be subordinate to the greater aims of the joint operation.

The unified commander integrates the activities of assigned forces by means of operational command. This involves the assignment of tasks; designation of objectives; and, generally, the direction necessary to ensure mission accomplishment (14:36). Several specific powers are granted to the unified commander which flesh out the general definition of operational command. The JCS recognized that critical military situations may necessitate adjustment to normal (peacetime) logistics procedures (14:38). This applies directly to transportation management since, as described previously, the services deal separately and directly with the TOAs to obtain movement of their supplies and equipment in peacetime.

Further support for the concept of unified command movement control in contingencies is found in the JCS Pub 2 subsection on the principles of unified command. Included among these is the principle of centralized direction to coordinate efforts of assigned forces (14:39).

The precondition of movement control, limited support capability, is addressed by JCS Pub 2 in the portion which sets criteria for establishing a unified command.

JCS Pub 2 provides the vehicle for movement control in its discussion of a "coordinating authority." This is particularly useful when coordination is not intended to disturb normal relationships (14:57).

The logistics support area is treated in detail in Section 6, JCS Pub 2. Several portions provide additional grounds for unified involvement in control of resupply movements. The segment which deals with unified command responsibility for direction in the logistics field specifically addresses the movement and distribution of materiel (14:84). The unified commander is also charged with coordination of transportation facilities and means assigned to his command (14:87).

JCS Pub 3, Vol I, "Joint Logistic Policy and Guidance," furnishes further philosophical basis and formal authority for direct unified command movement control. Its opening paragraphs outline some basic principles of logistics responsibility. Pertinent elements are:

(1) Uniform policies consistent with each service's most effective functioning.

(2) Coordination and standardization for transportation of supplies.

(3) Uniform standards, especially in transportation.

(4) Free exchange of information on all levels within the logistics structure (15:5).

Specific guidance on unified command logistics responsibilities in JCS Pub 3 permits the unified commander to exercise directive authority in the logistics field to ensure effectiveness and economy of operation (15:7). This complements assignment of responsibility for planning by unified commands (14:37). Directive authority is the logical, active extension of planning, which also enables the unified commander to be an effective manager.

Also, with regard to logistics planning, JCS Pub 3 directs that it shall include identification of water/air terminal capability, daily reception capacity, and limitations that could constrain movement. This function becomes highly critical during a contingency, when operational dynamics and enemy action can easily and dramatically alter the ability to receive cargo. It is consistent for the unified command to carry this planning task forward into the plan execution phase.

Finally, JCS Pub 15, "Mobility System Planning Compendium," states that the JCS may allocate, as necessary, capabilities of the TOAs to support movement requirements of approved plans (16:5). It further says that unified commanders have the same general responsibility as the JCS (16:6). While this cannot be taken literally, it certainly is applicable in the CINC's theater.

While none of the preceding publications explicitly states that unified commanders are directed or authorized to regulate supply flow in their theaters, it does provide for their involvement in coordination, direction, and policy making. Thus, we can infer from JCS guidance as to the authorization for and desirability of movement control. The evidence is extensive. To summarize, JCS consistently encourages unified policy and procedures when these will contribute to more effective operation. The special demands of crisis situations are acknowledged, and unified commanders are permitted to preempt peacetime logistics practice when necessary. The utility of centralized logistics management is recognized, and many statements are made about coordination and standardization in the transportation of supplies.

Plan Requirements

Operations plans express two types of movement requirements: force deployment and resupply associated with deploying forces and units already in the theater. The Joint Operations Planning System (JOPS) is the mechanism used to gather and analyze these various movement requirements. Unified commands normally collect requirements data from service components for the first 60-90 plan days. Once this information has been reviewed, adjusted, and validated, it is passed to the TOAs for movement analysis based on required delivery date. The TOAs match capability to the requirements and, considering a variety of operating constraints, optimize transport flow and set delivery schedules.

The resultant transportation flow plans are useful for feasibility analysis; however, they do not reflect all that would actually happen if a plan were executed. There are a host of intervening variables which may prescribe resequencing time-phased requirements, adding and deleting force elements, and changing the destination or composition of individual requirements.

Clausewitz described this sort of difficulty over 150 years ago. He used the term "friction" to account for the way minor problems accumulate and produce a general lowering of performance by military forces. He noted that friction is what distinguishes the real thing from war plans. Clausewitz maintained that leadership must anticipate friction in a general sense, avoid unreasonable expectations, and prepare to intervene rapidly to minimize its effects (17:119-120).

In current practice, TOAs take care of flow as best they can, using required delivery dates and relative movement priority to arbitrate between competing demands. The unified command monitors the overall system and intervenes on an ad hoc basis, but no policies or procedures are prescribed to govern the complex interaction that will be necessary in a contingency. At the very least, a good decision about which of two competing shipments moves first must include input from the shipper, the TOA, the consignee, the unified command, the sub-unified command, the in-country line haul activity, and probably the TOA responsible for an alternative mode.

Existing Movement Control Capability

The bulk of PACOM's movement control system was phased out in the early 1970s as the tempo of Vietnam operations dropped. Although an extensive dialogue occurred over whether to retain some minimal PAMPA capability as a nucleus for contingency response, budgetary constraints and manpower ceilings forced its closure in November 1974 (18). Other elements of the system, though, have survived.

The Pacific Airlift Management Office (PAMO) is the only vestige of PACOM's Vietnam era movement control network still playing an active role. It is responsible for intra-theater airlift management, a direct responsibility of the unified commander. The PACOM JTB exists on paper, but has met only a few times in the past five years. This affirms that in peacetime there is rarely any need for high-level adjudication between competing transportation requirements.

Now the burden of identifying problems lies mainly with PACOM's service components, who may push up to the unified level those problems they cannot resolve. Even though this method does work, it is flawed. Usually, when a problem surfaces, it is through a single component. In order to reach an equitable decision in the transportation area, the unified command must determine the impact on other components to avoid creating worse problems than were solved. Considerable time is required and much data correlation must take place, while the unified command tries to determine the best joint approach. Also, service components have an option. They may address problems through their service chain, which precludes prompt joint action and may result in negative effects where common user systems, such as the DTS, are involved.

A Movement Control Proposal

In view of the evidence in this paper alone, it should not be surprising that earlier studies recommended keeping a PACOM movement control system in readiness at all times. The JLRB Report contained the first formal recommendation for a permanent movement control organization; however, the report was not directive, and no DOD-wide action was taken to formally incorporate movement control into the unified command structure (3:153).

This article takes a different approach than past efforts, in the belief that any movement control plan at all is a vast improvement over the gap which exists now. Its premise is that, while most officials recognize the need for movement control in a contingency, maintenance of peacetime capability is a luxury which none can afford. The concept, therefore, calls for preparation of system documentation and operating agreements, which would be activated as needed. The extent of system activity and manning would be based on requirements of the particular contingency.

The viability of a stand-by concept such as this is always a concern; however, life could be maintained by a combination of methods. First, implementing instructions could be used to familiarize predesignated CINCPAC and service component staff members, who would be the source of initial manning for the system. Also, Reservists who perform annual active duty training at PACOM headquarters and who would be a potential source of contingency manning, could gain familiarity with the concept and basic procedures. Second, joint command post exercises could include movement control play. This would regularly test the system and help to refine procedures, develop data gathering methodology, etc. Third, and perhaps most vital, would be periodic PACOM staff visits to the TOAs and the JDA. These trips would familiarize key DTS components with PACOM's intentions, promote understanding of the concept, and permit development of practical working arrangements.

The Movement Control System

The system proposed here will be basic, but the concept's flexibility permits easy adaptation to any contingency or combination of contingencies. At the minimum, establishment of two new activities is required, plus unification of the PAMO. Additional offices could be opened as conditions demand, including sub-unified command movement control agencies.

Activating the System

The system would be activated in either of two ways. The first method would be by CINCPAC direction as part of the standard emergency action process employed whenever a crisis occurs. The activation decision would be predicated on CINCPAC Staff analysis of planned deployment and resupply requirements for forces involved. Other considerations would be transportation availability and port constraints. When it is judged that known requirements will place a heavy demand on movement and reception capability, the system would be rapidly activated to deal with problems while they are still manageable.

A second method of activation would be by decision of the PACOM JTB. Triggering considerations would be the same as above. This alternative would provide a way for senior theater logisticians to react in situations similar to that in the early Vietnam years, where no OPLAN was ever executed or specific crisis action response initiated.

Organizational Placement and Structure

Since CINCPAC's Organization and Functions Instruction already calls for the Mobility Operations Division of the Logistics Security Assistance Directorate to maintain ". . . a capability to implement DOD material flow control into, within, and out of PACOM commensurate with urgency of need, terminal capability, and movement resources availability," there is no issue on this point (19). In fact, the Mobility Operations Division (J43) presently performs a limited peacetime movement control function. The volume of actions is low enough to permit ad hoc staff response to

requests for assistance from TOAs or service components.

In a contingency, when the movement control system is activated, J43 would be concurrently designated the Pacific Command Transportation Management Agency (PATMA). This agency designation fits the JCS Pub 2 description of a "coordinating authority," as previously reviewed in this article, since J43 would specifically coordinate resupply activity among the services and not displace normal management systems.

Three field offices, each with a different orientation, would make up the movement control system. These would be located at Oakland, Yokohama, and Hickam AFB, so as to directly interface with DTS intermediate headquarters principally engaged in Pacific theater support. The Oakland and Yokohama offices would be new creations, while the Hickam office would be what is now PAMO. Their major functions would be as follows:

Oakland:

- *Monitor, evaluate, and analyze bookings and surface cargo flow from CONUS to PACOM.*
- *Monitor, evaluate, and analyze air cargo space assignments and flow from CONUS to PACOM.*
- *Ensure compliance with PACOM movement policies by CONUS shipping activities before materiel is accepted into the DTS.*

Yokohama:

- *Receive, review, evaluate, and validate intra-theater sealift movement requirements.*
- *Analyze WESTPAC waterport capability.*
- *Arrange for opportune Seventh Fleet lift.*

Hickam:

- *Receive, review, evaluate, and approve intra-theater airlift requests.*
- *Monitor MAC channel airlift in PACOM and coordinate as necessary to ensure optimal utilization and service.*

A Final Word

Reflection on this article might lead some to conclude that it is an effort to derive unified logistics doctrine. The movement control concept certainly meets all the classic tests of doctrinal formulation. It represents a collection of observations from numerous actual military experiences. Statements in this paper are the result of revision and refinement over years of real word operation. Finally, the concept has been abstracted or generalized to all contingency situations (20:5).

Instead, this article should be viewed merely as a means of disseminating a precept which has survived the harsh doctrinal process several times over, **but never survives the transition from war to peace.** As a consequence, the concept has been repeatedly lost, only to be "rediscovered" in the exigencies of the next conflict. The search for movement control invariably results in direct economic cost and, more importantly, reduced support to forces in combat.

Unfortunately, the very term "movement control" immediately causes concern in many quarters. The implications for unilateral service logistics management and TOA freedom of action are perceived negatively, rather than as a positive contribution to modern joint warfare.

Fortunately, despite the common misconceptions, authority for unified movement control exists in both an Act of Congress and joint publications. Also, the precedent for unified movement control was clearly established during the early, tumultuous years of U.S. involvement in Vietnam. RAdm Eccles put it well when he said:

> Movement control and carrier operation may be considered as two sides of the same broad coin of transportation. One directs the movement, the other carries it out. Both are interested in the same basic problems and information, but each places its own special emphasis on different aspects of these matters (2:164).

The relationship is complementary, not adversarial.

Whether or not the system proposed in this paper survives the staffing process intact is totally unimportant. What is critical is that it proves substantive enough to provoke analysis of existing, peacetime-oriented transportation management systems.

Mechanisms such as a movement control system must be immediately available to ease the transition from peace to war and ensure the most efficient resupply during war. **We must be prepared to function under conditions of scarcity, which the peacetime environment does not impose.** Only through interaction among TOAs, service components, and the unified command can agreements be reached that will enable prompt, effective contingency response. The stand-by organization proposed here is only one alternative, but it does possess the advantage of avoiding fixed manpower and economic cost, concerns which thwarted similar efforts in the past. It will also be immediately available.

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Leverage Leasing: A Way To Increase Defense Airlift

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Background

In May 1981, the respective presidents of Air Transport Association (ATA) and National Air Carriers Association (NACA) wrote similar letters to the Secretary of the Air Force. Both letters outlined problems in the commercial airline industry which impact U.S. defense airlift. These two letters, from the heads of organizations that represent virtually all of the major U.S. airlines, may be the most direct statements of the problems that the Defense Department, the Military Airlift Command, and the National Defense Transportation Association (NDTA) have been examining for at least the last three years. (14:41-42) In short, the major U.S. airlines are having economic difficulties which impact defense capabilities. The letters documented these crises and then listed proposals to help remedy the situation. This paper addresses one of the proposals: leverage leasing.

In a leveraged lease, profitable companies buy capital equipment from less profitable companies. They do so, not because they want to operate the equipment, but because the more profitable the company, the more important the tax credits associated with the capital equipment. For the purchase, the profitable company obtains funding from passive investors, thus the term "leverage." Since the profitable company does not really want to operate the equipment, it then leases it out. This concept of leverage leasing is used to ensure that the nation maintains adequate reserve civil airlift to meet national emergencies.

The Logic Chain and Links

There are several elements of reasoning one must go through in order to conclude that an analysis of leverage leasing is needed. These elements are identified as "links" in a "logic chain." Each element is essential to the logic of leverage leasing. The logic chain approach is also necessary because recent airlift programs seem to have difficulties when decision makers eliminate an essential link.

The logic links, along with a brief defense, are as follows:

The Nation needs more airlift.

The first link is the simplest, yet it is one that has caused the most controversy. We have moved from a national strategy of massive retaliation (which required little airlift), through the flexible response era (which brought out the C-141 and the C-5), and are now in a new strategy which calls for the force projection concept and specifically emphasizes the defense of NATO, Korea, and Southwest Asia. (1:30) We plan to do this with a smaller military than we had 11 years ago, a high proportion of which is stationed in the contiguous U.S. Also, we are doing it in a period of rising worldwide tensions, especially with the Soviets and their surrogates.

In spite of the *prima facie* evidence of the need for airlift, many have argued that there are in fact alternatives and we really do not need more airlift. In the 1979 hearings of the House Armed Services Committee, a committee staffer, Mr. Tony Battista, successfully argued for funds to be committed to sealift at the expense of airlift. He argued that because ships would be in the inventory earlier, they were better for deploying the rapid deployment force.

In defending his staffers' actions, the Chairman of the Research and Deployment Subcommittee of the House Armed Services Committee explained, "The House Armed Services Committee rejected the C-X on grounds that higher priorities existed and that the proposal had not been thought through." (6:10) In other words, he was not convinced of this first link in the deductive logic chain.

Fortunately, the Navy was able to take advantage of Congress' hesitancy and purchased SL-7 "fast" (able to travel 30 knots) sealift ships. This helped the mobility equation, although in a different way from airlift. However, airlift may be the essential element of mobility because, without it, there is no "rapid" deployment force.

The Department of Defense stance is that the three legs of the mobility triad (airlift, sealift, and pre-positioning) are in fact complementary. They should not be in competition with each other for the mobility dollar. Airlift is one way to ensure forces arrive in time, and sealift is the only way to sustain the tonnage required for a major war. Pre-positioning is a mixed blessing. It helps the tonnage problem, but the urgent need to get the troops to their pre-positioned equipment actually increases the need for airlift.

Airlift is the only way for the Rapid Deployment Joint Task Force to be "rapid." It is the only way to justify keeping increasing numbers of troops and equipment in the U.S. In short, unless national policy changes, more airlift is needed.

Approximately one-half of national wartime airlift will be provided by the Civil Reserve Air Fleet (CRAF).

This is both a war-planning fact and a statement of the faith the citizens of the U.S. have placed in their airlines. The Military Airlift Command is cognizant of that faith, and the following excerpt from their Management Report may be the best summary available:

> *The Airlift Partnership:* Since 1941, the Military Airlift Command has enjoyed a unique, close relationship with the civil US air industry - a relationship which may determine the outcome of future wars. To accomplish their goals, our war planners depend heavily on airlift, 50 percent of which is represented by the civil air sector. We have had, and we must continue to have, a single US air transport system to meet a crisis situation. This means that the two systems - civil and military - must be able to rapidly meld into a coordinated unity in order to protect vital national interests. This critical melding is particularly important today because the job to be done in the next war gives us less time than in the past and the requirements for air transportation are greater than ever before.
>
> At least 50 percent of the wartime airlift capacity is held by the civil industry. So the partnership is a very serious factor in our planning. We plan on our civilian partner being fully effective in 48 hours. This means the airplanes, the aircrews, the maintenance personnel, the

ground support, the civil airport, and management. We bring to bear the totality of the industry; we don't just bring in one element. (16:24)

This logic link says that through Military Airlift Command the citizens of the U.S. rely on commercial carriers for one-half of the national emergency airlift.

Commercial airlift should be considered a national wartime asset.

In World War II, in the Berlin airlift, in Korea, and even in Vietnam, military objectives were clearly supported by our commercial airlines. Deterioration in commercial airlift capability is therefore a military and national problem. Many nations recognize the importance of their national airlines and directly support them. (8:74-80)

In the U.S., we also have capitalized on our airlines' capabilities, but we have not had to directly support our national carriers as have other nations. The free market economy had them available when we needed them. This logic link, however, helps us recognize the national significance of a viable commercial airlift sector.

As a whole, U.S. trunk airlines are not economically healthy.

1981 was an especially bad year for the trunk airlines. The International Air Transport Association (IATA) in its mid-1981 analysis referred to the previous year as the worst in airline history, while predicting that IATA members would have a combined loss of some $2.5 billion (since reduced to $1.6 billion by increased fares and freight rates). For the nine top U.S. trunk airlines, losses were worse in 1981 than in any year in the history of the U.S. airlines. (3:26)

The problem became worse in 1982 and, although 1983 holds new hope because of reduced fuel prices, the next logic link still holds true—there is a growing need to invest in new equipment.

The major airlines are currently faced with a large need to invest in new aircraft to replace that which is retiring in the 1980s and to meet projected market growth.

Mr. Matthias B. Bowman, Managing Director of Merrill Lynch White Weld Capital Markets Group, addressed this issue in the spring of 1981. He was discussing investment needs for the airlines, which he said were $25-$35 billion in the next decade in excess of the funds that airline operations generate. He pointed out that already 58% of the trunk and regional airlines' overall capitalization was represented by debt, "an amount that most industrial corporations would consider a high degree of leverage." (18:9) He then pointed out that if one examines the industry without considering its two most profitable airlines (Delta and Northwest), total debt for the industry represented almost 65% of total capitalization.

Figures 1 through 3 show the plight of this industry on which half of our wartime capability depends. Figure 1 shows rates of return (ROI) for trunk airlines compared to total nonfinancial corporations. Note that in several years there was a negative ROI for this industry. Figure 2 then shows the earnings needed to meet traffic projections. Considering the evidence of Figure 1, the "minimum requirements" of Figure 2 seem unattainable. Figure 3 shows an additional problem. Air Transport Association predicts a growth in seat-miles required. Placed on the same chart with the present fleet capacity, the replacement needs are dramatic. The need to reinvest as illustrated in the last figure is a new phenomenon, at least in regard to the unprecedented size of the reinvestment need.

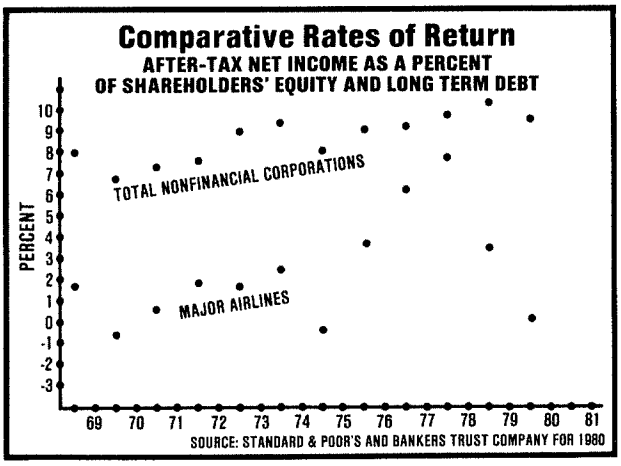
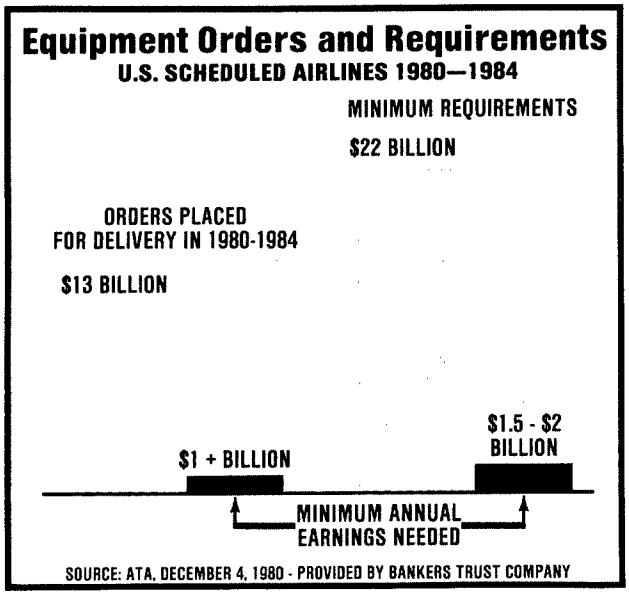


Figure 1.



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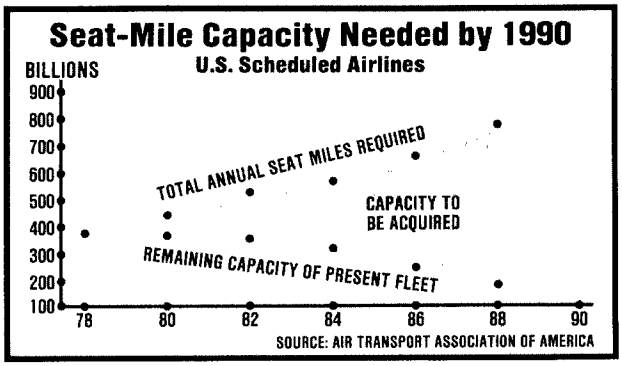

Figure 3.

The total airline fleet is looking less like DOD planners desire.

In 1978, Mr. Dick Ferris, Chairman of the Board of United Airlines, attended an Airlines Presidents Meeting with the Secretary of Defense and the Commander in Chief of the Military Airlift Command. During that meeting, he told them that United Airlines was buying Boeing 767s in large numbers, fully aware that this airplane does not satisfy defense needs, while replacing those which do. He apologized for having to buy an airplane that was not optimized for national emergencies.

He was right. The Boeing 767 and 757 are not what Defense planners would like to have available for emergency airlift augmentation. Neither are the Boeing 737-300 or the Douglas DC-9 Super 80, yet these are the aircraft now being bought by the industry. (12:46) *Aviation Week* called it a "shift in the market to the lower-fuel-burning twin engine transport." (5:13) What military planners would rather have available are the Boeing 747, the Douglas DC-10, the Lockheed L-1011, and pure cargo versions of long-range, narrow-bodied aircraft like the Boeing 707 and the Douglas DC-8.

Hard evidence exists to support this logic link. The airlines' fleet composition must be an increasing area of concern for DOD mobility planners.

Governmental actions are largely responsible for the problems illustrated in the previous two links.

Eight reasons for the airline industry's problems and changing fleet requirements can be isolated. Many of these are the direct result of governmental action rather than activities of the airlines themselves. They are:

(1) The highly competitive nature of the airline industry.

(2) The depressed U.S. economy.

(3) Increased airline operating costs, especially fuel.

(4) Deregulation and the "sunset" of the Civil Aeronautics Board (CAB).

(5) New airlift capability represented by increased capability of MAC organic airlift.

(6) Antipollution and noise abatement legislation.

(7) The "open skies" policy for international air traffic.

(8) The controllers strike.

The first three are self-explanatory. They are factors generally beyond the direct control of the government.

The last five airline problems are the result of, or can be linked directly to, governmental actions and a brief discussion of each will highlight the point made by this link of logic.

Deregulation and the Sunset of the CAB. Under the Deregulation Act of 1978, the Civil Aeronautics Board (CAB) will cease to exist, or "sunset," on 1 January 1985. Recently, there have been reports that Congress is considering an even earlier date. (10:38) The industry as a whole has gone through quite a debate on disestablishing the CAB and opening up route authority and fare structures to the free market system. The issue is not settled and will not be until the air travel industry stabilizes after the 1985 (or sooner) "sunset."

Because restrictions on fares and route approval have already been relaxed, however, some pertinent trends have developed. The first is a trend toward increasing numbers of regional carriers operating on shorter routes.

Deregulation has also influenced financing. In the past, financial institutions could make judgments as to future profitability of an airline based on a route structure guaranteed by the CAB. Now, because airlines have no guaranteed routes, the financial institutions are more reluctant to grant debt. (13:8) Here, Mr. Bowman's point should be recalled. There will be increasing needs for debt in this already leveraged industry throughout the next decade. (18:2)

New Airlift Capabilities of the Organic MAC Fleet. Worried about the increasing needs for airlift, the Military Airlift Command is increasing the capabilities of its own fleet. This creates airlift as a by-product of training. When that airlift hauls cargo that would have otherwise gone to a commercial carrier, there is a problem. In 1975, the president of ATA was already pointing out:

> Military cargo traffic, however, has been declining for the commercial airlines. The decline is far sharper than could be attributed solely to the winding down of U.S. military activity in Southeast Asia. The decline has come in percentage of available military traffic going to commercial airlines, as well as in tonnage. (7:14)

That problem will be made worse by the increased capability represented by the C-141 stretch and C-5 re-wing programs, and the procurement of new C-5s. As Col David Hinton pointed out, "The percent of the total Airlift Service Industrial Fund (ASIF) revenue awarded to commercial air carriers has steadily declined during the past ten years." (13:11) The trend should continue and be exacerbated by the organic fleet modification programs.

Antipollution and Noise Abatement. Pollution and noise restrictions were placed on the airlines by a government that in so doing subjugated Defense needs to those of ecology. The point is not that either should dominate; rather, both should be considered if they are affected.

The Open Skies Policy for International Air Traffic. "Open skies" is a term used to describe the government's willingness to allow foreign carriers to land at U.S. airports in return for allowing U.S. competition into their air markets. This policy was established by the Air Transportation Competition Act of 1979 which outlines goals to be followed in international bilateral negotiations. (19:1) Open skies is an extremely complex issue and the airlines themselves are split. (17:1)

The potential of an open skies policy for shaping the airlines needed for national emergencies is worth emphasizing. The international airlines are critical to CRAF, and it is this segment which is at the center of the open skies debate.

There is encouraging evidence the open skies problems will be nipped in the bud by the present administration. The open skies policy is of great interest to the Department of Defense if it signals the removal of desired aircraft from the international fleet of U.S. carriers. When open skies caused United to sell the Boeing 747 it was using for travel to Tokyo, that impacted our wartime airlift capabilities. Further reductions in the international air fleets of U.S. airlines are of necessity the concern of the Defense Department.

The Controller Strike. The airlines claim the controllers' strike has hurt their profitability, particularly when linked with an overall depressed demand for air travel. The extent of the decrease in 1981 profits due to the controllers' strike is purely speculative. The point is made here only to show the impact of government actions on the airline industry.

The five previous examples show that government action has influenced an industry vital to the USAF mission. The point is an important one, and one which has gone largely unstated by the military. That is, if actions of government bodies impact the nation's wartime capability, then those actions become a concern of the Department of Defense. So far, DOD has not asserted itself on this point. That it could, however, is an important part of the logic being developed in this paper. If the sunset of the CAB and deregulation affect Defense needs, then Defense has a right to react or at least be consulted.

Currently within the U.S. Civil Air Fleet, there is an excess passenger capacity for wartime needs.

This link in the logic is a backward way of saying there is not enough cargo capacity for wartime needs. It is illustrative to state it as is, though, because it leads to the question of what can be done to take advantage of excess passenger capacity. The Military Airlift Command's quarterly report observes the

relationship between excess passenger capacity and the commercial airlines:

> Almost all of the troops that deploy to a theater go by commercial aircraft. Fortunately, there is no foreseeable near-term shortfall in our ability to move troops; however, shortfalls do exist in other categories of airlift. In all major conflict scenarios - NATO, the Far East, the Middle East - cargo requirements have always exceeded capabilities. Furthermore, there are shortages in several vital categories of cargo. (16:24)

Therefore, we have the capability to get troops to the battle area before their equipment gets there, so we do not move those troops until the cargo movement catches up. We have a clear surplus of passenger capability; and if some of it could be converted to cargo, we could have a more balanced and more rapid movement of both troops and equipment to the battle area.

For those cargo classes that both sectors can carry, it is generally more cost-effective to increase surge capability in the commercial sector rather than in the military organic sector.

This depends, of course, on the costs of each option and on the base line military organic capability that must exist before there is a trade-off between civil and military airlift. The airlift mission can never be entirely relegated to commercial carriers. Almost half of the Army's heavy equipment will be classified as "outsize" by 1986. No commercial aircraft is capable of carrying outsize equipment; therefore, the outsize capability will remain a purely military requirement. Besides this, a certain amount of bulk and oversize capability should be maintained.

The point is still a good one, though, that once minimum military requirements are met by the organic fleet, increasing them can be cost-effective if done by commercial carriers. This means that a dollar spent on a new ton-mile of oversize or bulk cargo capability in the civil fleet may be better spent than on buying and maintaining that capability in the military organic fleet. The military fleet is necessary, and its proper size is constantly studied. However, if a civil airplane and a military airplane can do the same job with the same amount of flexibility and responsiveness, it is logical for the government to let somebody else pay for flying that airplane during peacetime.

Congress is willing to support programs to ensure the Civil Airline Fleet retains defense characteristics.

Primarily this refers to the CRAF Enhancement Program. Through fiscal year 1982, Congress appropriated $93.4 million for CRAF Enhancement, including $15.9 which was spent to modify a United Airlines DC-10. (2:1) CRAF Enhancement continued to be funded in spite of the fact that only one aircraft has actually been modified using enhancement funds since the original program was approved in 1976.

Under the CRAF Enhancement Program, an airplane which the airlines have purchased for passenger use is modified at government expense during production or in a program called "retrofit" if it has already seen service. The modification strengthens the cabin floor and adds cargo doors, in essence making it a convertible cargo aircraft. After the aircraft is modified, its owner flies the plane on normal routes in the passenger configuration. It is only to be converted to cargo in time of national emergency. The government pays for the modification costs, for downtime while it is being modified, and for the fuel penalty involved in the airline flying a heavier aircraft.

That the Congress would commit funds to modify civilian airplanes is of major importance in the world of airlift and has opened up a Pandora's box of alternate proposals for that money. For instance, operators of cargo DC-8s and Boeing 707s say that the money would be better spent re-engining their aircraft to meet noise and pollution standards. Without help, they say, those DC-8s and 707s will disappear from the U.S. commercial inventory. They also point out that with re-engining, the dollars spent represent more ton-miles than the dollars spent on the CRAF Enhancement modification.

There are a variety of alternate proposals for this money. In short, leverage leasing is one of those proposals and is in competition for the same dollar as the 707 re-engining proposal.

CRAF Enhancement is far from the highest priority line item in the budget. In fact, in every year CRAF Enhancement has been in the DOD budget, its amount has been cut by Congress. In FY83, funds were entirely zeroed out, both because of the lack of attractive airplanes and because of the unexpected high cost quotes from the airlines. (11:20) Although congressional support is not overwhelming, it is there.

Congressional actions also encourage leverage leasing.

The following is quoted from the Report of the Committee on Finance, 6 July 81, and concerns leverage leasing:

> Three party financing leases ("leverage" leases) are now widely used to transfer tax benefits to users of property who do not have sufficient tax liability to absorb those benefits. The Committee has decided to facilitate the transfer of ACRS (Accelerated Cost Recovery System) benefits through these types of transactions. . . . Since the Committee has decided that lease characterizations should be more available, the Committee bill establishes an exception to current judicial and administrative guidelines dealing with leasing transactions. (15:2)

The congressional attitude expressed above was perhaps overly ambitious. In 1982, "safe harbor" leasing was severely restricted by Congress—a move which would seem to indicate a change of course. However, it was not that radical a change. Elimination of the special leverage lease called "safe harbor" did not change the overall thrust of congressional attitude. Instead, Congress continues to embrace the idea that companies should be allowed to use all of their tax credits—and the use of leveraged leases. To do so is still within congressional goals. Only the most extreme "safe harbor" leases have been discontinued by late 1982 tax legislation.

Most airlines are not now in a position to take advantage of all their tax benefits because of poor overall economic performance.

This is due to heavily leveraged purchases of new equipment and the generally poor economic performance outlined in logic link four. There are exceptions to this general rule. Some airlines, because of their profitability, are not interested in selling tax benefits. (4:28)

Airlines are willing to participate in leverage leasing arrangements.

According to Mr. Bowman, "Airlines have traditionally relied on the leasing market for a significant portion of their financing needs." (18:8) Furthermore,

> Since airlines will be obtaining a large volume of new equipment in a relatively brief period over the next few years, and they will doubtless have more depreciation and tax credits than they can use, we anticipate

considerable growth in the lease market, not withstanding the operator's desire to retain residual values. (18:9)

That statement may have underestimated the rush of airlines to the leasing market, especially for sale-leaseback and the "safe harbor" derivative.

The Boeing Company provided an excellent insight into the overall size of the leasing market for the types of aircraft which would be attractive for a government supported leasing program. The leasing market is there, according to this link in the logic, and airlines are eager to take advantage of the leasing advantages provided by Congress.

The airlines will want to fly long-range, wide-bodied aircraft which the government has modified to be cargo convertible.

This concept is supported by recent events. Although orders by U.S. airlines for long-range, wide-bodied aircraft have declined, there are a substantial number of these already available. When the Military Airlift Command issued a Request for Proposal (RFP) to the airline industry, the initial response was an offer of 125 airplanes to be modified if an acceptable price could be obtained. This shows that there are airplanes available for modification and that there is no reluctance by the airlines to having their aircraft modified if the inducement is appropriate.

Leverage Leasing Financing

Financial leases (and the lease-back process) have been available for years. The reason leasing was not dominant in the previous finances of major companies was because the Financial Accounting Standards Board and the Internal Revenue Service had very stringent requirements and restrictions for leveraged leases. The Economic Recovery Tax Act of 1981 wiped away most of those restrictions and made leverage leasing financing much more attractive. The basic industrial "lease-or-buy" decision has been altered by allowing potential lessors to take tax benefits which they previously could not. In fact, the number of leases is expected to *triple* in the next two years. (9:111) This has caused major confusion in the equity financing market. Therefore, a special form of leverage leasing has been designed to help solve the military airlift shortfall.

Recommendations

To see if leverage leasing is the best way to ensure an inventory of commercial airplanes that meets defense needs, the following recommendations are proposed:

(1) *Remove Legal and Legislative Barriers.* The leverage leasing process requires legislation. Although many people are dubious about the leverage leasing proposal getting through Congress, I feel they may embrace the process with open arms for the following reasons:

(a) Cost: It promises to be very low compared to CRAF Enhancement without leasing. In fact, it may bring money into the public coffers.

(b) Impact on Capital Investment: The business disinterest in capital investment is beginning to worry economists and Congress reflects this concern. It can be generally stated that considering the Y (national income) = C + I + G formula, the present administration is attempting to cut G (government spending) while increasing C (consumer spending) and stimulating I (business capital investment). The "I" has been underpublicized, but the Economic Recovery Tax Act of 1981 emphasizes the importance of investment to the overall recovery plan. A leverage leasing plan as outlined in this paper fits perfectly the congressional mood toward stimulation of capital investment.

(c) Cheap Defense: The defense bandwagon has been overloaded by congressmen, who want to be a part of the overwhelming administration mandate. Many congressmen, however, have adopted the theme that even though they are *for* big defense, they are really for big defense with less money. One example of this thinking is personified by the group called "reformists" who are pushing for increased numbers of more simple (and therefore cheaper) airplanes. Leverage leasing promises more airlift for fewer dollars.

(d) Aid to Ailing Industry: The large airlines are experiencing financial problems and this makes Congress uneasy. It appears that the impotence of the major trunk airlines is now regretted by the very politicians who did the castration. Leverage leasing promises some relief to the industry segment whose virility is necessary to national defense.

(e) Advantages of Free Market: Leverage leasing avoids the appearance of subsidy by putting the modified airplanes onto the open market. Rather than hamper the free market system for air travel, it participates and encourages it. The airplanes will be leased to the highest bidder; that is, the most profitable airline. It will not be a subsidy for those which are failing.

(f) Jobs: By keeping airplanes in the inventory, jobs are created in both the manufacturing and the airline sectors.

(2) *Determine Reaction of Airlines.* This, rather than the legislative question, should be the major cause of concern. If it is ever implemented, the leverage leasing concept will dictate to the airlines what aircraft type to fly. That is, once a long term lease is signed, the airplane will be in the U.S. inventory for an estimated 16 years regardless of what the airlines would like. Since the sublease to an airline will be done on a bid basis, someone will fly the modified airplane, even at loss of money. In this case, it means an airline will be forced to bid for the lease, even if it would rather fly some other airplane. It is recommended, therefore, that the airline reaction be studied in depth.

(3) *Investigate Cost Figures.* Cost figures should be narrowed through more investigation. The area of investigation should be on current lease rates, leverages, and aircraft costs.

Conclusion

Leverage leasing seems to be feasible and to fit the needs of both industry and the military. It is also a financially attractive way for the Department of Defense to meet its air mobility goals. Based on current tax laws and trends in the industry, there is a financial opportunity to put cargo capabilities into commercial passenger jets at a low cost to the taxpayer. Furthermore, leverage leasing avoids the appearance of government subsidy for the airlines and stimulates the economy. The opportunity is there and future studies will determine the outcome.

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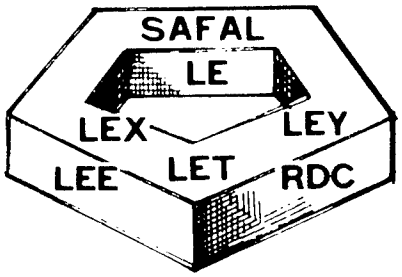

USAF LOGISTICS POLICY INSIGHT

Total Force Readied

Secretary of Defense Caspar Weinberger charged all Service Secretaries and the Chairman, JCS, in a 21 June 1982 memo, with ensuring the Total Force Policy is manifested in all our management systems. Specifically, all Select Reserve units must meet deployment times and readiness required by contingency plans. "Units that fight first must also be equipped first" has become an often quoted by-line, and the Air Force has taken steps to resolve shortages and solve active/reserve equipment modernization imbalances. Several Air Staff organizations evaluated and revised precedence ratings and force/activity designators (FADs) assigned to Air National Guard (ANG)/Air Force Reserve (AFR) flying units. Now ANG/AFR flying units have the same priority for requesting materiel as active AF units with similar OPLAN tasking. Congress is closely monitoring the equipment inventories of ANG and AFR via a new Annex to the Force Readiness Report, submitted annually in February. It has also established a new appropriation specifically for procurement of ANG/AFR equipment. New in FY83, the appropriation provides an additional $15 million for each reserve component. More special appropriations are expected in FY84.

Containerized Ammunition Expanded

The Air Force is leading the way toward increased use of containers to move munitions to the Pacific. As breakbulk ships leave commercial service, their availability in wartime poses serious difficulties. In August 1981, the Air Force moved 86 MILVANs from CONUS storage sites to Korean munitions storage areas. This successful test provided many valuable lessons as well as an assessment of port-handling and transfer capability. During a second test in May 1982, the Air Force moved 50 MILVANS from Okinawa to Korea, at which time intratheater movement procedures were evaluated. The test also provided an opportunity to handle live munitions using techniques developed as a result of the first test.

WRM (Vehicles) Revised

War Readiness Materiel (WRM) vehicle management policy contained in AFR 400-24, Chapter 6, was recently revised to give MAJCOMs more flexibility to control overall program assets. Installation commanders now have the authority to release a WRM vehicle for up to three days. MAJCOMs will have the authority for release up to 60 days. Beyond 60 days requires HQ USAF approval. All Harvest Bare assets remain under HQ USAF release authority.

Shale-Derived JP-4 Used

In early 1984, the Air Force plans to start conversion of Hill AFB to shale oil-derived JP-4. Conversion of Mountain Home AFB will follow about three to four months later. Exclusive supply of shale-derived JP-4 to these bases for at least two years is the final step in the overall program to validate the use of synthetically derived jet fuel in Air Force aircraft. Shale-derived JP-4 is a high quality product that conforms to the same specifications (MIL-T-5624L) as JP-4 derived from conventional petroleum sources. It is neither a new nor test fuel. Before the Operational Validation Program begins at Hill AFB, ASD will have completed an extensive R&D effort and examined the use of over 2 million gallons of shale JP-4 during accelerated mission tests on TF-30 and F100-PW-200 engine assets. Successful completion of this program will represent a significant positive step in demonstrating the use of another domestic secure source of energy.

Aircrew Manning Constraints on the Civil Reserve Air Fleet (CRAF)

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Abstract

The Civil Reserve Air Fleet (CRAF) is a concept whereby Department of Defense (DOD) can use commercial aircraft, aircrews, and support capability to augment organic military airlift in periods of increased airlift requirements. Although the airline pilots are ready and willing to fly the missions, technical and administrative procedures are currently constraining aircrew availability.

This paper analyzes the aircrew manning constraints which may limit the movement of CRAF-committed airplanes during wartime conditions and recommends strategies to overcome the deficiencies in the CRAF program.

Background

Civil air carriers have augmented military airlift in every major contingency dating back to World War II. Their participation has been purely voluntary and they have performed commendably. As our national defense strategy shifted from massive retaliation to flexible response, with emphasis on rapid deployment, significant shortfalls developed in our organic military airlift. With limited defense budgets, military planners were forced to increase their dependence on commercial airlift. Today, approximately 50% of our total airlift capability resides in the Civil Reserve Air Fleet.

CRAF is currently an integral part of most military contingency plans involving massive airlift; but, because of prohibitive costs, it has never been fully exercised. CRAF's true maximum airlift capability, therefore, will probably never be known until the need arises. As a result, some decision-makers have questioned whether CRAF assets can be relied upon during a national emergency. Most of this concern has been centered on the availability of aircraft and on the CRAF enhancement program—a program which basically involves a modification of commercial passenger aircraft so they can be converted for the movement of cargo when CRAF is activated. Although planners have assumed that aircrew support would not be a problem, military leaders feel apprehensive about planning to fight a war with resources over which they have no direct control. Also, in the case of the CRAF program, mission effectiveness will generally depend upon civilian aircrews with no military obligation. The question of dependability, therefore, must exist in the minds of some decision-makers. Will the civilian airline pilots step forward and fulfill their CRAF obligation when the time comes?

When this study was initiated, our perception was that airline pilot support might be less reliable than assumed by CRAF planners. Furthermore, we had serious reservations about the willingness of airline pilots to fly into known hostile areas.

Some CRAF supporters argue that CRAF aircrews will not be required to fly into areas of hostility. Even by regulation, "CRAF aircrews are not expected to accept the same hazards as military personnel; therefore, CRAF missions must be assured a high degree of safety from enemy action."[1] Commercial aircraft in the past, however, have been subjected to ground fire while flying in support of military airlift operations, of which Vietnam is certainly a documented example. Testimony before the House Armed Services Committee indicates that CRAF-committed air carriers and crews are prepared to supply combat forces in a combat theater.[2] Current DOD mobility studies also envision full CRAF participation in airlift operations in a NATO war.[3] No one can guarantee, therefore, that CRAF crews will not be subjected to some form of hostile activity in a major conflict involving the United States.

When you approach CRAF proponents about the possibility of a shortage of aircrews in a maximum airlift effort, they immediately point to historical examples of successful commercial augmentation to military airlift. Such examples, however, involved limited airline resources, were fairly small-scale in nature, and occurred in a relatively nonhostile environment.* This study will focus on massive airlift under wartime conditions when CRAF could be pushed to its maximum capability—involving the alert of 388 commercial aircraft and the required crews activated within 48 hours. Will there be a manpower shortfall?

Findings

When we initiated this study, all four of us anticipated that airline management might have a manpower shortfall if CRAF were activated to its maximum airlift capability. Although our findings support our preconceived conclusion, the study also identifies other problem areas, not originally anticipated, which could have a serious impact on available manpower.

If all present manning constraints were enforced and CRAF were activated today to its maximum capability, only 36% of the pilots would be available and legal to fly CRAF missions. This figure, however, can be very misleading. The low

*American Airlines promptly responded to Operation Baby Lift during the Vietnam withdrawal. According to Mr. Stanley Seltzer, American's CRAF liaison to the Military Airlift Command (MAC), his company prepositioned a Boeing 747 and crew even before MAC formally requested airlift assistance. They had four aircraft involved and flew 27 flights between Vietnam and Guam. Seltzer stated that more crewmembers volunteered than could be used in the operation.[4] Pan American's liaison representative, Mr. Frank Matola, related how in late 1979, just before the takeover of the American Embassy in Tehran, Iran, United States personnel were evacuated from Tehran, under very tense conditions, by Pan Am aircraft and volunteer crews. Again, more crews volunteered than were needed.[5]

percentage is not because of pilot attitudinal problems or unwillingness to fly into hostile areas, as originally anticipated, but because of technical and administrative personnel constraints. The pilot support, to the contrary and much to our surprise, is overwhelmingly favorable with 99% supporting the CRAF concept and 82% willing to fly into hostile areas. Fortunately, by implementing our suggested recommendations, this 36% figure can be improved sufficiently to allow CRAF to perform its airlift mission.

The following are our specific findings categorized into the three major areas of research: availability, attitude, and awareness of commitment.

Availability

The term "available" in this study refers to those pilots ready, willing, eligible, and qualified to fly CRAF missions. With one exception, company mobilization representatives (MOBREPs) unanimously agree that airline management considers all their pilots potential CRAF crewmembers. The pilots qualified on CRAF equipment at the time of activation will be a pool of available crewmembers from which CRAF missions will be manned.

This realization is contrary to our initial impression that each airline has a core of pilots specially designated as CRAF crewmembers. When we discussed this concept with MOBREPs, most of them pointed out how difficult it would be to maintain a specific group of crewmembers earmarked for CRAF operations. The record keeping would be tremendously complicated with the continual changing of crew status among airline pilots. From a personnel management standpoint, it is only practical to consider all pilots as possible CRAF crewmembers. This reality is very important in understanding CRAF personnel constraints. If all pilots flying CRAF-committed airplanes are considered potential CRAF crewmembers, management must consider the following additional factors to ensure crews are legally available to fly CRAF missions.

(1) *Security Clearances.* Only 61% of all CRAF pilots are positive they have a security clearance. All cockpit crewmembers, under present directives, must possess a secret clearance which allows them to carry required classified authentication documents. Although the company MOBREPs see the necessity for the requirement, several indicated the crewmembers do not understand the need because they believe the CRAF missions will function with or without a clearance. Last year one of the major carriers placed a notice on the pilots' bulletin board asking for volunteers to support CRAF by filling out the necessary forms for a security clearance. Only *nine pilots* out of some *two thousand* signed up. Reportedly, the paperwork is time-consuming to complete and is of no real immediate personal value to the crewmember.

An educational process appears essential, for this is a serious constraint which could limit available crewmembers. If this one single problem were resolved, the availability of pilots would increase immediately from 36% to 67%—a manning level at which airline management probably could fulfill their CRAF commitment with only minor changes in manpower planning.

All CRAF airline personnel who will be involved in the planning of CRAF operations, attend classified briefings, or are crewmembers on CRAF aircraft will be required to possess a security clearance of SECRET. These requirements are stated in MACR 55-8 and appropriate industrial security regulations. The Defense Industrial Security Clearance Office (DISCO) in Columbus, Ohio, maintains a listing of all CRAF personnel who possess a SECRET security clearance. Company security officers likewise maintain a list of cleared personnel. Because of the burdensome and costly task of updating MACR 55-5 (CRAF Personnel Security Clearance Report) every six months along with inaccuracies which could have led to security compromise, the regulation has been rescinded. Security clearance information relative to CRAF personnel can be obtained from the company security officer or DISCO.

(2) *International Pilot Qualification.* Although commercial aircraft dedicated to CRAF meet the long-range capability requirements, some are not used daily on international routes; therefore, the pilots may not be internationally qualified. The results of the questionnaire indicate that 9% of all CRAF crewmembers are presently not qualified by company standards to fly an international flight. This means that if CRAF were activated tomorrow to its maximum capability, approximately 440 CRAF pilots possibly would not be qualified to fly strategic airlift missions. This finding is more prominent among scheduled carriers who contribute about 70% of the total number of strategic aircraft. Presently, 12% of their pilots are not internationally qualified.

This qualification problem is most prominent among airlines that fly both domestic and international routes, as well as those that fly only a few transoceanic legs. International pilots have qualification requirements over and above domestic requirements, such as additional navigational training. Pilots can easily become noncurrent for international flights. One way is to bid and fly only domestic flights on long-range aircraft. Also airlines frequently cut back their international operations during slow periods of travel and reschedule their equipment on domestic routes. Additionally, a pilot can lose qualification by upgrading in crew position or by being forced to downgrade as a company furloughs.

A vice president for operations of one major carrier expressed a real concern that his pilots may lack international qualifications necessary for CRAF missions. This particular airline has a large number of long-range aircraft committed to CRAF. The majority of its flights, however, are either flown domestically or to the Caribbean and South America. Since international navigational procedures are considerably different, his concern is that many pilots may need additional training before flying CRAF missions. However, the aircraft do not have sextant ports and Air Force navigators would be unfamiliar with the onboard navigational equipment.

We can conclude that while losing 9% of the CRAF pilots because of international qualification may not appear significant, it could have a definite impact on a few scheduled air carriers and the effectiveness of CRAF.

(3) *Reserve and National Guard Pilots.* Only 8% of CRAF pilots are active in Reserve units. Airline companies do not track pilots' Reserve affiliation. Most MOBREPs were unconcerned about this conflict of duty because they believe Reserve pilots, if necessary, will fly for CRAF anyway. MACR 55-8, however, explicitly states, "Carrier personnel who have a military Reserve or National Guard commitment *will not* be considered available for carrier duty in support of CRAF activation."[6]

Though only 8% of CRAF pilots are Reservists, the airlines lose up to 11% of their crews to the Reserve Forces upon

CRAF activation. While it is true that captains can fly as first officers, first officers cannot fly as flight engineers without additional training. This finding could again be significant, especially when considered in light of other personnel constraints.

(4) *Report Time*. 86% of the CRAF pilots can report for duty within 24 hours; 12% need 24-48 hours; and only 2% need more than 48 hours. It should be noted that the pilots were asked on the questionnaire to indicate a reasonable report time under "normal" conditions. Since a significant percentage of airline pilots commute to their domicile via air travel, the word "normal" can have ambiguous connotations. For a pilot living in Atlanta, Georgia, and commuting to JFK International Airport, the company must be able to promptly contact him by telephone to allow him to catch a timely commuter flight. Also, air traffic must be operating "normally" with regard to weather conditions and air traffic control. The disruption of air travel, however, would be very likely if CRAF were activated on a massive scale since aircraft committed to the program would be pulled from some domestic flights. Therefore, while it is true that CRAF airplanes can be launched within the prescribed times under normal conditions, perhaps some thought should be given to abnormal conditions such as traffic disruptions during a national emergency.

The implication of this finding, although it is less quantifiable than others, is that fewer crews may be available at the start of a CRAF call-up than anticipated. Fortunately, the responses to the questions related to report times were encouraging, but it would be prudent to consider the possibility of delayed reporting times along with other constraints.

Attitude

The word "attitude" in this study encompasses pilot support and understanding of CRAF. Generally speaking, we were again surprised at the positive, overwhelming pilot support for the program, although the majority do not have an adequate understanding of the concept and their associated responsibilities. Our questionnaire examined pilot attitude in four areas:

(1) *Pilots' Attitude Toward CRAF*. 86% of the pilots believe CRAF is the most economical means for the United States to provide the required airlift during a national emergency. Almost all of the crewmembers (99%) will support CRAF, for various reasons, during a national emergency. The reasons were: to help the country increase its airlift capability, to support their company, and to protect their jobs.

(2) *Flying into Hostile Areas*. When we asked the pilots if they would be willing to fly CRAF missions into hostile areas, the total support figure dropped from 99% to 82%. This means that the other 17% will support CRAF, but only into a nonhostile environment.

We feel the study indicates tremendous pilot support for the program—much stronger than we imagined. The 82% support for flying into hostile areas should relieve the anxieties of some military leaders. Nevertheless, when the 18% who will not fly into hostile areas (including the 1% who will not support CRAF under any conditions) is analyzed in conjunction with the previous findings, as we shall see later, the cumulative effect on manpower constraints is very significant.

We can conclude, however, that airline pilots are responsible, patriotic citizens, willing to support CRAF. As airline employees, they are as dedicated to their company as military personnel are to their respective service. As one MOBREP put it, "They will fly wherever the company tells them to fly."[7] Another MOBREP interviewed said, "Our pilots will fly anywhere, anytime to accomplish the DOD airlift requirements. Just provide our flight crews with beds and food and they'll get the job done."[8] This company loyalty and positive attitude was substantiated by the questionnaire responses.

(3) *Military Experience*. 85% of all CRAF pilots have had previous military experience. This finding can lead to many interesting conjectures, some of which are conflicting. First, we feel this preponderance of military experience must have some positive influence on pilots' ability to recognize and understand the CRAF requirement and willingness to support the program. Secondly, perhaps their military training, coupled with Military Airlift Command (MAC) charter flight experience, explains why CRAF missions into hostile areas do not appear threatening. They have been there before. It is interesting to note, however, that 16% of those who said they would not fly into a hostile environment have also served in the military. Possibly, they were either exposed to a bad combat experience while on active duty or left the service to avoid the possibility.

The only sound conclusion which can be drawn from this finding is that if the time comes and CRAF is activated, decision-makers should feel some comfort knowing that the majority of the aircrews have had military experience and support the program.

(4) *Understanding of the CRAF Program*. 62% of the pilots either have not been or do not recall having been briefed on CRAF. This lack of understanding may very well generate a cloud of ambiguity and a degree of indifference toward the program. However, with the overwhelmingly sincere support of those contacted during the research phase, we believe latent positive attitudes exist which are only waiting to be nurtured.

We conclude, therefore, that a well-planned educational program aimed at the pilots would help resolve many of the previously mentioned constraints. Most MOBREPs agree that such a program would be beneficial to all, including upper airline management.

Awareness of Commitment

A crewmember can be committed to CRAF through a personal commitment, through a company commitment, or through the pilots' working agreement (contract). It was evident that many pilots simply do not know how or to what extent they are legally obliged to support CRAF. The related findings are:

(1) *Pilot Commitment to CRAF*. Approximately 58% of the pilots know they are committed to support CRAF, while the other 42% either do not know or are sure they are not committed. Only one airline has its CRAF pilots sign a form documenting their personal commitment. Some crewmembers agree to be committed before they are employed (mostly among the supplemental carriers), while others are contractually committed after employment.

Nearly all CRAF airlines have CRAF language in their contracts. In most cases, the pilots are contractually committed to support the program. However, 43% of the crewmembers are either not sure or believe that CRAF is not

mentioned in their contracts. This disparity may arise because of the different terminology used in the various contracts to describe "military operations." In many cases, the word "CRAF" is not even specifically mentioned. This vagueness leads many pilots to think that MAC charter flights and CRAF missions are synonymous. We also found very little similarity among contracts with respect to areas and detail of coverage. Some of the areas partially covered in different contracts are CRAF manning procedures, pay and allowances, payment for "hostile" action, life insurance coverage under CRAF, and non-strike clauses.

While airline management is considering *all* pilots committed to CRAF, many crewmembers are totally unaware of either the commitment or the documentation of their commitment. Obviously, individuals need to understand their commitment in order to understand their responsibilities. We conclude it is best for all concerned if pilots are contractually committed in clear language that specifically distinguishes CRAF from MAC charter flights. This would ensure the pilots' rights and benefits while flying under CRAF and also serve as a legal documentation of their commitment. According to Mr. John P. Bradley, Manager of Contract Administration for the Air Line Pilots Association (ALPA), "If a pilot is contractually obligated to CRAF and doesn't show for a CRAF mission, he doesn't get paid."[9]

(2) *Flight Attendant Commitment.* Under the CRAF program, about 215 long-range aircraft are dedicated to passenger airlift. Flight attendants will be required as part of the crew complement. It is simply assumed at this point they will support the program. Little has been done to include them in the communications process. The MOBREPs confirmed our concern that flight attendants have been almost totally ignored in the planning of CRAF.

Though nine airlines are committed to passenger airlift missions, not one representative for the flight attendants even knew about the CRAF program. Of the nine airlines involved, only one airline flight attendant contract even mentions CRAF. This particular contract, however, is very elaborate and covers the CRAF program in much greater detail than most pilot contracts. One other flight attendant contract has a no-strike clause which would apply to CRAF, although CRAF is not mentioned *per se*.

It does not seem prudent to totally ignore the flight attendants and simply assume they will support the program. Since CRAF is heavily dedicated to passenger airlift, flight attendants also need to be committed to the program. They want to know what is expected of them and how they fit into the overall plan. Flight attendants need to know, not just to satisfy a personal interest, but so their benefits can be contractually protected.

Recommendations

The following recommendations are proposed to relieve the constraints to ensure an effective CRAF operation:

(1) Training and Education:

(a) Since a majority of CRAF pilots are either vaguely informed or uninformed about the program, which may have resulted in a lack of understanding of aircrew commitment and responsibilities, a briefing should be assembled in the form of a videotape presentation to be shown during recurrent ground training. The contents of the briefing should focus on the major aspects of MACR 55-8 (background and purpose of CRAF, pilot responsibilities and procedures, security clearance requirements, etc.).

(b) An educational program should be developed by the Air Force and coordinated with the Directors of Flying for all CRAF airlines.

(2) Security Clearances:

(a) The Air Force urgently needs to review airline security clearance requirements and procedures for CRAF cockpit crewmembers. We question, for example, why commercial flight engineers really need a security clearance. Could captains and first officers not handle the authentication and safe-passage requirements? If so, this would reduce the requirement for security clearances by one-third. Supplemental carriers normally have professional flight engineers who do not upgrade in crew position and, therefore, would never require a security clearance. When *firm* requirements are determined, airline management should be strongly encouraged to ensure strict compliance.

(b) We also suggest that a special abbreviated clearance form be designed for former military officers serving in the CRAF program. This would not only expedite application procedures but would encourage participation.

(c) In addition, we feel a security clearance should either be a condition for hire or a prerequisite for upgrade. This requirement could be tailored to suit the airlines' needs.

(d) We sincerely feel that our first recommendation, the videotape briefing, will be very effective in resolving this problem simply by increasing the pilots' awareness of the necessity for a clearance.

(e) We recommend that the Air Force put top priority on security clearance requirements and procedures for CRAF cockpit crewmembers and encourage strict compliance by airline management.

(3) Constraints on Pilot Availability:

(a) Airline management needs to be more aware of constraints on pilot availability in their planning for CRAF operations. Most airlines do not consider the possible loss of Reservists, of pilots who may be unqualified for international flights, or of those who may not want to fly military missions—particularly into hostile areas. These factors, in conjunction with the deficiency in security clearances, could cause the airlines a problem in manning their aircraft for a sustained 10-hour daily utilization rate. In this study we have assumed a crew ratio of 5:1 for the involved airlines (as prescribed by the majority of the MOBREPs), but results of the questionnaires indicate that only one-third of the pilots may be available. One partial solution would be to plan for a 4:1 crew ratio with flying and crew duty day limitations of all airlines immediately reverting, upon CRAF activation, to something similar to MAC standards. These measures would at least reduce the required number of CRAF pilots.

(b) We recommend that the Air Force encourage airline management to take a more realistic look at their available manpower in light of the findings in this study. They should determine the minimum crew ratio for a 10-hour daily utilization rate and all airlines should collectively establish "war-time" flight and crew duty day limitations.

(4) International Qualification Problems:

(a) Airline management should identify international qualification problems among their CRAF pilot force. Methods should be devised, such as selective scheduling of qualified with unqualified pilots or appropriate waivers, to minimize the impact on CRAF operations.

(b) We recommend that the Air Force encourage airline management to examine this possible manning constraint within each airline and act to limit the impact as much as possible while ensuring a safe operation under national emergency conditions.

(5) Commitment to Support CRAF:

(a) Because of the general lack of knowledge of their commitment to support CRAF, pilots should be directly and firmly committed by their airline companies to support the program. Recurrent ground training would be an effective means to emphasize each crewmembers' commitment to CRAF; however, a specific declaration in the airline contract would be desirable and would make the commitment more meaningful to all concerned. Airline flight attendants should receive the same CRAF training as other crewmembers. Although MACR 55-8 states that flight attendants are not required on cargo missions, a large majority of CRAF missions will be passenger flights; therefore, attendants will be needed.

(b) We recommend that the Air Force encourage airline management, the pilots' unions, and flight attendants' unions to negotiate more specific and meaningful CRAF language into airline contracts.

(6) Reserve Pilots in CRAF:

(a) Since some airline managers question the obligation of their Reserve pilots, we suggest that MACR 55-8 be clarified to remove all doubt about a Reservist's first loyalty when the CRAF program is activated.

(b) We recommend that the Air Force ensure that airline management understands a Reservist's obligation during a national emergency. Furthermore, we suggest that airlines track their Reserve pilots to preclude scheduling them for CRAF missions since they will probably be mobilized to fulfill their military duties.

Conclusions

At this point, it is important to understand the cumulative impact of our findings on the CRAF operation. To determine this impact, we designed a computerized matrix to factor *out* three airline manning constraints identified in this study: (1) the 18% who will not fly into hostile areas, (2) the 8% who are active in Reserve units and (3) the 9% who are not internationally qualified. The cumulative net result, with duplications eliminated, is that only 67% of all CRAF pilots will be available for a maximum airlift contingency into a hostile environment. This figure includes neither the sick nor those on vacation who are not recallable.

If on top of this 67% we factor *out* all pilots who do not have a security clearance, the availability of crewmembers rapidly decreases to 36%. Therefore, we feel it is a conservative conclusion that if CRAF were activated tomorrow to its maximum capability, with all present manning constraints enforced, only 36% of the pilots would be ready, willing, and legal to fly CRAF missions into a hostile area.

Although this may depict the worst possible scenario, clearly it points out that airlines may not have enough available manpower. Can they perform their CRAF mission? Yes—providing steps are taken to relieve personnel constraints and minor changes are made in manpower planning.

For example, if pilots understood the need for a security clearance and they all obtained one, the percentage of available crewmembers would jump from 36% to 67%. This one factor alone would allow airline management to meet their CRAF commitment, providing they revised their planned crew ratio and crew duty day.

Most airlines presently employ five to six crews per aircraft. The MOBREPs claim they will need a 5:1 ratio to generate the planned 10-hour-per-day aircraft utilization rate under present airline contracts. MACR 55-8 does provide airline management the opportunity to revert to a higher crew duty day limitation, but MOBREPs say the companies will fly CRAF missions under their respective contracts. We conclude, therefore, that in light of the identified personnel constraints, some of which cannot be totally resolved, airline management should plan to support CRAF with a lower crew ratio and a higher "war-time" crew duty day to ensure an adequate manning level.

We feel this study conclusively supports that the airline pilots have a positive attitude toward CRAF and are ready and willing to fly the missions. It is the technical and administrative procedures which are constraining available manpower. Thus, the proposed recommendations should be implemented as soon as possible to reduce the impact of these constraints and allow the airlines to fulfill their CRAF responsibilities.

Notes

[1]*Operations, Civil Reserve Air Fleet*, Military Airlift Command Regulation 55-8, Vol I (Scott Air Force Base, IL.: Department of the Air Force, 11 October 1981), pp. 3-4 (paragraph 3-11f).

[2]C.F. U.S. Congress, House Armed Services Committee, *The Posture of the U.S. Military Airlift*, H.R. 2637, 95th Cong., 1st sess., 1977, p. 43.

[3]C.F. U.S. Congress, Congressional Budget Office, *U.S. Airlift Forces: Enhancement Alternatives for NATO and Non-NATO Contingencies* (Washington: U.S. Government Printing Office, 1979), p. 8.

[4]Telephone Conversation with Stanley L. Seltzer, Mobilization Representative for American Airlines, Dallas-Fort Worth Airport Station, TX, 8 November 1981.

[5]Telephone Conversation with Frank P. Motola, Mobilization Representative for Pan American World Airways, Jamaica, NY, 15 December 1981.

[6]*Operations, Civil Reserve Air Fleet*, Military Airlift Command Regulation 55-8, Vol I (Scott Air Force Base, IL.: Department of the Air Force, 11 October 1981), p. 2-1 (paragraph 2-8b).

[7]Telephone Conversation with Francis E. Curran, Mobilization Representative for Transamerica Airlines, Oakland, CA, 12 November 1982.

[8]Telephone Conversation with Henry Benajh, Mobilization Representative for Capitol International Airways, Smyrna, TN, 17 November 1981.

[9]Interview with J. P. Bradley, Manager of Contract Administrations, Air Line Pilots Association, Washington, D.C., 29 October 1981.

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18. Bowman, Matthias B. "Trends in Airline Financing in the United States Past and Future," Speech to the Airfinance Conference, New York, New York: 14 April 1981.
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CAREER AND PERSONNEL INFORMATION

Civilian Career Management

Logistics Civilian Career Enhancement Program (LCCEP)

It is easy to have misconceptions about anything that is not totally familiar. A recent letter from a Cadre member presented a lack of confidence in the LCCEP. Several criticisms were made indicating insufficient familiarity with the selection criteria for promotion. It is time to review the bidding. Here is an analysis of an LCCEP member's geographic availability as reflected in the PDS-C official record:

ANALYSIS OF GS-12 LCCEP CANDIDATE'S GEOGRAPHIC AVAILABILITY

Lowest Available Grade	*Location*
1. GS-14	McChord AFB (DF)
2. GS-14	Norton AFB (EL)
3. GS-14	SAMSO LAAFS (EM)
4. GS-13	Brooks AFB (FN)
5. GS-13	Kelly AFB (FR)
6. GS-13	Lackland AFB (FS)
7. GS-13	12 FTW Randolph AFB (FU)
8. GS-13	HQ ESC Kelly AFB (FX)
9. GS-13	HQ ATC Randolph AFB (F2)
10. GS-13	OCPO Randolph AFB (F3)
11. GS-13	HQ AFMPC Randolph AFB (F4)
12. GS-13	AFMEA Randolph AFB (F5)

Lines 1, 4, 6, and 7. There are no LCCEP career executive positions above GS-12 at these locations.

Lines 2 and 3. Candidate is registered for GS-14 at these two locations. There are no GS-14 positions filled as developmental GS-13/14. As a GS-12, that would have been the only circumstance under which one could receive consideration.

Lines 9 and 10. Candidate was not registered in the LCCEP for these locations, although registered in the Central Skills Bank (CSB).

Lines 11 and 12. There are no LCCEP positions in these organizations.

In the case mentioned, there was very little, if any, mobility outside of one metropolitan area. The applicant had registered for two locations where no LCCEP positions existed in the skills that he possessed. At two locations, the grade indicated on the AF Form 2675 (Geographic Availability) was two grades higher than the individual's grade, thereby limiting consideration to only developmental promotions to the higher target grade (the occurrence of such action is less than .5%). Also, there were three locations for which the applicant had registered in the CSB but not in the LCCEP. The review of the bidding indicates the need for all LCCEP candidates to check their records. Make sure you know the difference between career programs and CSB; then be sure you are properly registered in *both*. In addition, you can register in more than one career program, such as Logistics and Comptroller, if your background and experience or education qualify you for the appropriate program. The open season for registration in these programs will be announced by your local CCPO.

At this point, you should ensure your registration is the same for all programs so that you may be considered for all vacancies in the occupational series for which you qualify. When this step is complete, check to see if there are any positions at the grade you indicated at the locations for which you are registered. Remember that the eligibility criterion is "1 year at the next lower grade." You must have served 12 months (not including detail) at the GS-11 level before you become eligible for a GS-12. Although geographic availability is tremendously important, so is the rest of your record.

When it is time for selection, a career brief of your history is furnished to the selecting official for information and consideration in a final selection decision. Some of the major factors are work history, in-service education, formal education, and recency of self-improvement efforts. These factors are very important and are all a matter of record, if your career brief is current and displays all of your experience.

An often-heard phrase for nonmobility is "children in school." Although bona fide, the fact is that children adjust to conditions faster than adults. The real impact is on the career employee. Do you sincerely wish to improve your abilities and opportunities, or are you in a well-worn niche? Mobility is a must if career progression and development is the goal you are attempting to reach. The real opportunity is in mobility. Are you really mobile? Are you willing to make a temporary sacrifice for a long-term gain in your career? When you are truly mobile, the number of opportunities is multiplied tenfold. There are any number of reasons for not moving; however, the bulk of them can be overcome. The cost of moving to a new location is the most often heard—not really true. The expense is borne by the Air Force for all reasonable costs; i.e., shipment of household goods, house-hunting trips, and real estate fees. The cross-training or "crossing over" to another occupational series in order to broaden your career is tremendously important, especially at the GS-11/12 grades. Your logistics background and knowledge are best gained at these levels.

The final word—keep your records updated, make yourself available to the widest possible number of locations, be truly mobile, and continue to enhance your logistics career.

Source: "Mac" McKeegan, OCPO/MPKCL, Randolph AFB TX

Military Career Management

Educational Opportunities for Logisticians

In addition to the technical training courses for each logistics career field, the Air Force provides the following educational programs for furthering the development of qualified logistics officers.

Air Force Institute of Technology (AFIT) Graduate Degree Programs. Currently, programs are available at the master's level in supply management, transportation management, maintenance management, logistics management, international logistics, contracting and manufacturing management, and acquisition logistics management. Each program is conducted through the AFIT resident program at Wright-Patterson AFB, Ohio, and the normal length is 15 months. To volunteer for one of these AFIT graduate degree programs, an officer must request an academic evaluation from the AFIT Director of Admissions (AFIT/RR). Instructions for submitting such requests and information on AFIT selection procedures are contained in AFM 50-5, Volume I, Chapter 4. Individuals are nominated for AFIT selection board consideration by AFMPC resource managers based on individual qualifications and advanced degree requirements in each career field. The AFIT selection progress begins in the late summer and continues until all available AFIT quotas are filled.

AFIT Education-With-Industry (EWI) Programs. EWI is designed to provide selected officers with "hands-on" experience with civilian industry's organization, management, and technology. Officers are assigned for ten months to a civilian company and work with company officials in the corporate setting. Companies throughout the United States are participants. The knowledge gained is then applied to the officer's Air Force specialty when reassigned following the EWI tour. The FY83 EWI programs available for "loggies" were in transportation, logistics, aircraft maintenance, munitions, supply management, fuels management, contracting/manufacturing, and quality assurance. The eligibility criteria and application/selection procedures are the same as previously discussed for AFIT graduate degree programs. Interested individuals are encouraged to discuss their desires with AFMPC resource managers and through narrative remarks on their AF Form 90.

RAND Research Fellows. Each year HQ USAF/LE identifies an individual to work with the RAND organization at Santa Monica, California. The objectives of this program are: (a) to place an outstanding Air Force officer in a primary research position with RAND to learn advanced research techniques while working on research of interest to the logistics community and (b) to build personal and professional relationships with the research community to establish a crossflow of information and ideas regarding military issues and policies. The normal tour for this program is ten months, beginning in August each year. No academic credit is given and there is no direct duty assignment. However, following the tour, HQ USAF/LE usually requests a follow-on assignment to their staff. Generally, field grade officers possessing a minimum of a master's degree qualify. Officers may volunteer for consideration by completing an AF Form 90. Volunteer applications must be received at AFMPC by the end of each calendar year to ensure nomination consideration. Final selection is made by HQ USAF/LE and announced each spring.

Air Staff Training (ASTRA) Program. The objective of ASTRA is to expose highly competitive young officers to Air Staff operations. Officers selected for this program are assigned to HQ USAF agencies for a 12-month training period as management interns. It should be noted that there are no selection quotas by Air Force specialty code (AFSC). Logistics officers who meet basic qualification requirements must compete, based upon their individual records, with all other volunteers, regardless of AFSC. There is a two-year eligibility window for ASTRA consideration which is based on an officer's total active federal commissioned service data (TAFCSD). For example, to be considered by the CY83 ASTRA selection board (for a FY85 ASTRA assignment), an officer must have a TAFCSD in 1978 and 1979. To be eligible for the CY84 selection board (FY86 ASTRA assignment), an officer must have a TAFCSD of 1979 or 1980. The TAFCSD window of eligibility follows the same progression of deleting and adding a year group for each subsequent selection board. In addition to meeting the TAFCSD criteria to apply for ASTRA, an officer must have completed Squadron Officer School and met certain base residency and DEROS (if overseas) requirements. Local CBPOs can provide details. Officers may apply via the special duty application of the AF Form 90. Officers must volunteer before 1 November. Each December the records of eligible ASTRA volunteers are processed through a central selection board at AFMPC and announcement is made in January. Applicants who are not selected are automatically considered by the next selection board if they remain eligible or unless they change their volunteer status on their AF Form 90.

Other AFIT Programs. Two additional programs which are available for qualified logisticians are the OLMSTED Scholar Program and the White House Fellows Program. The OLMSTED Scholar Program annually allows selected officers to study at an overseas university for two years to gain an in-depth knowledge and understanding of the social, political, economic, and international relations characteristics of that country. The White House Fellows Program, while not strictly an Air Force program, does allow officers who are selected to work full-time for one year as special assistants to high-level executives in Cabinet-level agencies or in the Executive Office of the President or Vice President. Further program descriptions and eligibility criteria for these two programs are contained in AFR 36-20 (Officer Assignments), Chapter 8.

Consideration for these programs is initiated by application. Integral to the final selection in all of these programs is the voluntary nature of the assignments.

Source: HQ AFMPC/MPCRPC2 (AUTOVON 487–4053)

Most Significant Article Award

The Editorial Advisory Board has selected "Air Force Logistics Strategy for the 1990s" by Colonel Harry L. Gregory, Jr., USAF, as the most significant article in the Spring issue of the *Air Force Journal of Logistics*.

What About Logistics?

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Introduction

Aerospace strategy and tactics have long been primary topics of concern to our senior officials both inside and outside of the Department of Defense. Considerable time and effort have been devoted toward the development of credible strategic and tactical doctrines to defend our national interests. Various strategies are continually under review to find better methods of projecting military power. Throughout this process, one central question has usually been avoided: What about logistics? In the world of airpower, as in other military realms, logistics has long been relegated to a category of secondary importance. In many cases, the crucial logistical implications of current strategies and tactics are not even addressed, much less investigated and resolved.

Clausewitz once defined the concepts of strategy and tactics: "Tactics is the art of using troops in battle; strategy is the art of using battles to win the war." Logistics, then, is the art and science that makes both tactics and strategies attainable. In military operations, logistics is responsible for maintaining and sustaining military forces. The objective of this paper is to evaluate the dominance of logistics over both strategy and tactics, and to encourage a more serious examination of logistical implications in connection with strategic and tactical planning initiatives. Therefore, to establish the dominance of logistics, three themes will be developed: (1) logistics determines military capability, (2) logistics determines tactics, and (3) logistics determines strategy. A review of existing logistical realities and their impact on strategy and tactics will, finally, reinforce the critical necessity for us to examine logistical implications early in any strategic or tactical exercises.

Logistics Determines Capability

Regardless of the definition of military capability, the logistics system determines the capability of each individual weapon system. While that statement is accepted as fact within the logistics community, there is a great deal of skepticism among strategists and tacticians. However, each aircraft possesses only a *potential* to perform certain missions. The logistics system determines whether the aircraft possesses any *actual* military capability at any given time as well as what the character or nature of that capability may be.

"It is this control that makes logistics such a dominating influence in the successful employment of strategies and tactics."

While virtually any logistics resource controls the capability of aircraft, consider for the moment only the impacts of the three resources of fuels, munitions, and spares. No aircraft can perform any designed mission without the fuels to move to the target. The lack of munitions may prevent the performance of, for example, the interdiction or air-to-air missions assigned to the aircraft. And even if both fuel and munitions are in plentiful supply, the lack of spares may prevent the aircraft from even leaving the hangar. Colonel Fred Gluck, a noted logistics theorist, referred to these logistical impacts as inherent design deficiencies that exist to varying degrees in all weapon systems. Obviously, there is no weapon system that does not contain a number of these deficiencies that will eventually be resolved by the performance of the logistics system. In other words, what the logistics system provides in terms of both the types and the quantities of resources determines the nature of the capability for individual aircraft, individual wings, and the entire operating theater. It is this control that makes logistics such a dominating influence in the successful employment of strategies and tactics.

Logistics Determines Tactics

While the tacticians plan the battlefield, the logistics system determines where and how the field units fight. Both the level and type of fighting are logistically constrained. The capacity of the logistics network to acquire and push resources into the theater controls the level of conflict. If demands exceed the capacity of the logistics pipeline, then operations will either be scaled down or abandoned. The type of fighting is, also, logistically controlled by the kinds of resources shipped into the theater. Operations may be delayed or dropped, not for insufficient capacity, but because the unique resources required to support operations were not available. Indeed, there is ample evidence to suggest that logistics has, in fact, greatly impacted tactics in past conflicts.

The general level of fighting in World War II was logistically regulated. In the North African campaign, the Allied advances were suddenly stopped because the advancing forces had outstripped the ability of the logistics system to provide resources in the required quantities. Once the logistics system had collected sufficient resources to sustain further operations, the advance in North Africa could resume. During the Normandy invasion, the reluctance of the front-line commanders to release the troop and supply ships almost proved disastrous to the invasion. Without the release of the ships, the reinforcements (both men and materiel) essential to the operations could not be shipped to the beachhead from Britain. Quick actions by the Allied headquarter units freed enough ships from the front line to enable reinforcements to move. In both Korea and Vietnam, the front-line forces faced the same resource movement difficulties encountered in World War II. While there were adequate stocks moving to the theater, insufficient port facilities and distribution resources inhibited redistribution in the theater.

Logistics, also, determines the fighting options open to a commander by the type of support it can offer. Again, in World War II, the high altitude bombing missions launched from Britain were considered quite successful. However, when they were suddenly called to a halt, the reason was not for lack of munitions, parts, or fuel. The special crew clothing required for these missions had not been shipped into the theater. The bombing missions were resumed only when the clothing had been acquired. More recently, in Vietnam, airpower actions were substantially reduced due to logistical constraints. Tactical changes called for the use of specified munitions for the missions. Airpower actions were curtailed until sufficient quantities of the specified munitions could be located and shipped into the theater by special airlift.

Logistics Determines Strategy

"Under each level, logistics establishes the basis for success."

Strategy determines the battlefield tactics. At its center, strategy encompasses two unique levels that are both logistically dominated. An overall or grand strategy is directed toward the development of the forces necessary to support national goals. Once the decision has been made to fight, however, a second specific or wartime strategy broadly defines the objectives required to sustain military operations until a particular conflict or action can be favorably resolved. Under each level, logistics establishes the basis for success.

The overall strategy can be best considered a preparatory stage taken before a conflict arises or the decision to enter it has been made. This level of strategy encompasses the development of two main objectives: (1) the ready units to support national objectives and (2) the structures to support these units over prolonged periods of time. Overall strategy is synonymous with two commonly used terms—readiness and sustainability.

Readiness entails the maintenance of both the airframes and the personnel. Both rely on an effective logistics system. The readiness of the airframes depends on the ability of the logistics system to acquire sufficient resources to maintain them in operational status. This includes not only the aircraft but also the munitions and support equipment essential to its flying mission. The dominance of the logistics system is best illustrated by the fact that, in the Tactical Air Command alone, the approximate equivalent of three and one-half wings of aircraft is grounded each day due to a shortage of parts. The logistical problems associated with fuels and munitions have impacted not only the weapon system readiness but also the proficiency of the pilots who must fly them. Training missions have been reduced both in terms of quantity and quality. The fuels shortages have restricted the number and types of training missions. Shortages of several types of key, high technology missiles have also helped to reduce the training missions and, consequently, the pilot's knowledge of the operating characteristics of his technological weaponry.

But overall strategy also includes the sustainability of those units that are committed to a conflict. Again, the logistics system determines the success of any prolonged military effort. The industrial base controls the projection of military power. Industrial planning is essential to ensure the availability of sufficient capacity and materials to meet the resource requirements of war. Current industrial capacity is shrinking, and the effects have already been felt in the aircraft industry. In some cases, the production lead time for critical airframe elements and their supporting systems has climbed to more than three years. The raw and refined materials required to make the various parts of an airplane are in critical supply. Congressional hearings into the strategic stockpile revealed substantial shortfalls between what should be in the stockpile and what elements are actually on hand. To change the industrial base and its impact on sustainability will require many years of adjustment and redirection based upon a national sense of need and a strong commitment.

The specific or wartime strategy establishes the overall objectives of the conflict and identifies the individual steps necessary to achieve them. To this area, logistics is a critical, almost overriding, consideration in the three primary applications of wartime strategy: force movement, force reconstitution, and force direction. To support the movement of forces, logistics must be involved because overall victory can only be sustained with resources. In World War II, the forces at Bataan surrendered not because the Japanese overwhelmed them, but because logistical considerations had been neglected. While the strategy was to withdraw to a defensive position, the ample, available food and ammunition supplies were not moved along with or in advance of the forces. Thus, surrender became the only viable alternative to starvation.

Force reconstitution has been discussed as an application of strategy to employ when friendly forces have been decimated, there is a need to launch an offensive, or there is a need to stop an offensive. In any of these cases, massive amounts of all types of resources are required in a very short, constrained period. Obviously, the logistics system plays a critical role in the process. The logistician must identify the requirements, obtain the necessary resources, and distribute them into the theater to the location desired. Without the ability to reconstitute forces, the battle can be lost. The Japanese have been credited with losing the Battle of Guadalcanal due to their inability to reconstitute forces. The Japanese needed to concentrate a large number of forces within a short time. Because they had neglected the logistical implications inherent in their strategies, they possessed neither the knowledge nor the ability to acquire the needed resources for massive reinforcement of the in-place units. The result was a defeat of the main forces on the island and the subsequent defeat of the small, piecemeal reinforcements that slowly began to arrive.

Force direction is also uniquely logistical. Aimed at reducing the ability of the enemy to continue the hostilities, this application is supported by the logistics network as well as being directed at the enemy's logistical system. In World War II, the Korean War, and the Vietnamese War, the Air Force has been engaged in strategic bombing actions directed at enemy logistical systems. The most recent example was the attempt to disrupt the Ho Chi Minh Trail. The inability of the Air Force to appreciably stop the flow of resources contributed to the ability of the enemy to continue operations in South Vietnam.

Logistics Realities

While strategies and tactics are quickly adapted to changing situations and objectives, the logistics system is a long and complex process requiring complete and careful management to make any significant changes in objectives or results. This

system contains such functions as supply, maintenance, contracting, transportation, engineering, and logistics plans. With these functional elements, the military logistics system must contract for and manage the flow of four major operations: (1) the raw materials to the refining plants, (2) the refined materials to the bit and piece, subcomponent, and component manufacturers, (3) the bits and pieces to the subcomponent and component makers, and (4) the materials from all three contractors to the military warehouses. This complexity is magnified when the millions of items managed by the military, the information systems transferring the specification and technical information, and the transportation system that joins these processes together are added into the logistics picture. When the repair and disposal operations are included, the logistics system becomes not only large but unwieldy. For the F-15 alone, the major contractors number around 300, while the total contractors involved at all levels of resource support number in the thousands.

"The Air Force has estimated that the mobilization of the F-15 production line will take 39 months...."

Given this environment, it should be understandable that changes may require years to institute. In addition, there is so little of this structure that can actually be controlled by military demands. Any external change that affects the production base, the quality of repair, or the transportation system can dramatically change the capability of the logistics network to support military forces. Today, those impacts are likely to be more severe than at any other period. While weapon systems and their resource requirements have become more complex and expensive, the funding levels necessary to support these systems have been reduced. Even in critical spares, such as the War Readiness Spares Kits, the funding levels over fiscal years 1980 and 1981 have been held below 40% of requirements. Once the decision is made to buy these spares, the current production lead times will cause delays from 22 to 30 months. Furthermore, the generation of additional aircraft to support a conflict is even more difficult to increase. The Air Force has estimated that the mobilization of the F-15 production line will take 39 months before the first additional F-15 over the peacetime production rate could be produced.

Conclusion

The military capability of any Air Force weapon system is logistically dependent. No aircraft or group of aircraft can properly function without the infusion of logistics resources. This dependence on logistics carries over into the tactical and strategic arenas. While only a few examples were presented, military history is littered with tactical and strategic failures attributable solely to logistical oversights.

Because of these impacts, logistics can no longer be operationally ignored. It controls too much of the war-making capabilities of the Air Force. Any actions which are taken by a wing or MAJCOM commander are logistically regulated. Failure to include logistics in the operational arena has led to results ranging from mission impairment, in the best cases, to total defeat in the worst.

To make logistics more responsive to operational requirements, two major developments must take place. First, operational commanders must cultivate a more complete understanding of the logistics process as it relates to their missions. The commander (wing, major command, or theater) makes the ultimate decision concerning the employment of forces including the support functions. Only with his awareness of logistical impacts is it likely that these problems will receive command support and resolution. Secondly, the operational commanders and planners must be willing to commit resources to the logistics system. By its very nature, the logistics process cannot change quickly to meet operational needs without prior and proper planning and management. Operational managers must evaluate the logistical impacts against various options to obtain the best quality of support for tactics and strategy. Such options might include the trade-off of more new aircraft for more resources to support existing systems and war plans.

There is only one way to ensure that logistics is properly addressed in operational plans and activities. The operational commanders must recognize the impacts of logistics on operational performance; and, once recognized, these operational planners and managers must be prepared to take the necessary steps to ensure logistical support. Only then will the question raised at the outset be realistically addressed: What about logistics?

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"For example, the SA-9 very much resembles the American "Schaparel." The SA-8 resembles the European "Orlando." The anti-tank "Pagot" has a great resemblance to the "Milan." The characteristics, I might add, are typical of the Russian systems. They are, as it were, stolen from the West; the Russians always produce them at a higher technological and efficient level of performance and in more simplified versions. The MiG-25 is a good example—updated and upgraded, resembling the Western fighter aircraft."

Lt Gen Rafael Eitan,
Israeli Defense Forces

Potential of Logistics Research and Development (R&D)

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Need for Logistics R&D

It has only been in the last few years that the term "logistics R&D" has reached a high level of attention; and in the only too recent past, the same neglect was in fact true for logistics itself. However, with the current emphasis on readiness and sustainability, we now need to take a new and closer look at logistics and find ways to improve its disciplines.

This technological age challenges these disciplines to support and sustain the weapons of today and the future. Yet, the same technology that makes our weapon systems more difficult to support can also make the support techniques more effective. But, as with all other problems, proper time, energy, and money must be committed to it.

We must think of logistics and technology from two viewpoints: one interfacing with and supporting weapon systems with new technology and the other using the same new technology in our support systems. The vehicle for accomplishing these two aspects is logistics research and development.

What is "logistics research and development?" We could probably derive several acceptable versions of a formal definition; but, fundamentally, all of them involve the methodology of improving the individual logistics disciplines by performing R&D. Using the logistics disciplines, as defined in DODD 5000.39, we then need to plan, fund, and perform the necessary technology insertion processes.

LOGISTICS DISCIPLINES	
Maintenance concept	Manpower and personnel
Support equipment	Computer resources support
Training and training devices	Facilities
Technical data	Packaging, handling, storage, and transportation
Supply support	Reliability and maintainability interface
	(Added in new draft of 5000.39)

By matrixing this list of logistics disciplines against one of emerging, or existing, technologies or processes, improvement of supportability can be achieved (Figure 1,A).

The Defense Science Board, over a year ago, determined the following list of key technologies that will be prevalent in the military future.

By using these improved disciplines on specific weapon systems, the insertion process can be mechanized (Figure 1,B).

Or, as can be seen by combining the three, an idealistic planning cube can be created (Figure 1,C).

KEY TECHNOLOGIES
VHSIC
Stealth technology
Advanced software
Microprocessor-based learning aids
Fail-safe/fault-tolerant electronics
Rapid solidification technology
Machine intelligence (A.I.)
Supercomputers
Advanced composite materials
High density, monolithic focal plane antennas
Radiation hardened advanced electronics
Space nuclear power
High power microwave generators
Large space structures
Optoelectronics
Space based radar
Short wave length lasers

The perfected logistics R&D programs would therefore bring improved logistics techniques via technology insertion to sustain specific weapon systems. This concept may be somewhat idealistic, and simplistic, but really it is no different than the plans process for improving the potential of any recognized discipline of warfare.

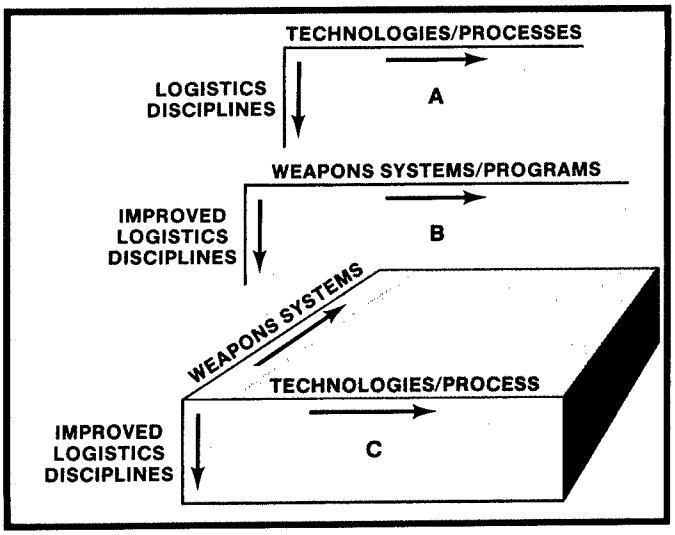

Figure 1,A,B,C.

DOD Recognition of Need

Recognition of the need to improve the logistics disciplines can be found as a part of the program to improve acquisition techniques. The key point then is that system readiness and sustainability are as important as system performance. In

particular, specific recommendations have been included to improve support and readiness, provide early funding for test hardware, establish contractor incentives for better reliability and support, and develop standard off-the-shelf support systems.

Another example is provided by a directive issued early in 1982 by Dr. Richard DeLauer, Under Secretary of Defense for Research and Engineering, who highlighted the crucial need for increased emphasis on logistics R&D and stressed the importance of technical innovation. He also asked for the establishment of a focal point for logistics R&D, with each service providing assistance and technical guidance to industry.

These efforts are brought into perspective when one considers the costs connected with weapon systems maintenance. Statistics show that the maintenance for an equipment inventory of approximately $200 billion dollars (at original purchase) costs a staggering $20 billion dollars per year. Obviously, future cost containment, coupled with quality support, will only be possible if the Department of Defense (DOD) and industry form a joint offensive to inject innovation into logistics support.

Supportability Issues

The problem with logistics funding is not necessarily so much that it is *too little,* but that it is often *too late,* and then misdirected. Supportability must be effectively communicated and cooperatively managed from the beginning. We have to start in the laboratory, where tomorrow's technology is being mechanized today into the materials, processes, and parts which will find their way into the weapon systems of tomorrow. If they are not inherently supportable at the time they are first expressed in prototype, it will be difficult or impossible later when the triple pressures of competitive cost, performance, and schedule become significant.

Therefore, we must infuse supportability, as a criterion of worthiness, into the minds of the scientists and advanced technologists who are making the devices we will be using tomorrow, and support logistics research and development as a legitimate avenue of pursuit in its own right. Only through research and development will we be able to increase the leverage that logistics can exert over both costs and service.

Emphasis on the "total systems" in the minds of our weapon systems managers is important. They must think of the total system as their weapon system plus its users. This concept must then be coupled with that of design system/support system parity; that is, the design and support systems must be treated in the same time frame, with the same emphasis, from conception to operational fielding.

Current Logistics R&D

As previously stated, the application of new technologies to logistics disciplines can in itself improve the capabilities of industry and the services to support weapon systems. Funding is also being planned, budgeted, and applied by in-house service laboratory programs, independent research and development, and contractual R&D programs.

The USAF has established the Air Force Coordinating Office for Logistics Research (AFCOLR) at Wright-Patterson Air Force Base which collects and coordinates logistics R&D needs throughout the Air Force. A compendium of logistics R&D programs and requirements is published annually.

The Air Force Human Resources Laboratory conducts research for logistics disciplines and, in addition to its own in-house programs, included the following contractual projects in recent years:

(1) *Acquisition of supportable systems evaluation technology (ASSET).* This program has provided an array of planning models and methods to assist in the acquisition of logistics support. It provides an early assessment of human and logistics resources and costs required for support and operation of weapon systems. It also permits integrated task analysis to define operational and maintenance task requirements in the areas of human skills, technical training, and maintenance manuals.

(2) *Maintenance diagnostics.* The purpose of this study was to enhance weapon system readiness by improving maintenance diagnostics decisions during the avionics maintenance cycle. The approach involves the selection of avionics systems as sources of data, creation of a mathematical simulation model to identify key maintenance decisions, use of existing data to estimate error rates, and results of laboratory field experiments.

(3) *Logistics support analysis handbook.* This handbook, which is being developed for the Air Force, will provide logistics support analysis guidance which is a key to the Carlucci initiatives and other directives. It will result from an analysis of policy and procurement regulations and procedures and a survey of users needs. The content of the handbook is currently limited to the concept development validation and full-scale development at position phases.

These three R&D projects do not necessarily apply directly to the technologies discussed; however, they are non-hardware producing contracts which will assist in planning proper logistics support for future programs. Some recent examples of hardware producing programs from logistics R&D are:

(1) *MATE (modular automatic test equipment).* This program is currently under contract from the Aeronautical Systems Division (ASD) to produce a system of modular automatic test equipment for Air Force use and may end the proliferation of the many types of automated test equipment for use by future systems.

(2) *Portable maintenance devices.* Several service and industrial laboratories have projects underway to develop test and maintenance systems which will be very portable. It is intended that these systems will transfer maintenance knowledge directly to the user from a local or remote site. All the systems concern a technique of displaying information directly to the maintenance user from some form of video and audio terminal. One system even includes a helmet-mounted instruction system which will give the user not only audio but visual information concerning his unit.

(3) *Integrated self-instructive test equipment.* Modern electronics techniques are being investigated to combine testing, training, and data into one package.

(4) *Remote systems maintenance.* Ground based radar installations that will be minimally manned or unmanned will require maintenance procedures beyond the traditional technique. The technique is one that will allow maintenance knowledge and information to be readily transferred between the system under test and the technician. The fundamental ingredients are the system to be maintained, the repair center, and a communication link between them. Depending on the degree of sophistication, various levels of redundance maintenance could be performed. Even a simple telephone link is sufficient for determining system status or for providing

assistance to a technician who has otherwise run out of troubleshooting options. By incorporating automatic test equipment at the remote site, system test, along with diagnostics and fault isolation, may be performed on command. Repair could even be accomplished by providing appropriate robotics by supply of spare relying replaceable units. And, finally, operating maintenance software could also be remotely reprogrammed to meet changing scenarios. Remote maintenance is not limited to ground based radar systems; it can apply wherever a traditional on-site maintenance capability is desirable or would need additional support. Its capability is best achieved in stages. By using a building block approach, the initial impact on the prime system can be minimized, provided adequate access to test information is made available in the design. A maintenance interface indicator would have to be provided in the original system design. Although applicable now, this technique will have high importance to future space systems where, of course, availability of local maintenance personnel will not be possible. This can be accomplished if the plan early specifies maintenance in this fashion. Remote maintenance can be very helpful for the future, since it can help minimize the need for large numbers of highly qualified maintenance personnel and yet maximize a system readiness.

Advanced Logistics R&D Programs

Examples of more advanced programs are:

(1) *Optical test signal extraction.* This technique was spawned by the need to test high speed signals in future systems. High speed test signals suffer degradation when conducted to measurement equipment by long electrical cables. To prevent this and the resulting inaccurate measurements, the electrical signals are converted to optical signals by special electro-optic transducers on printed circuit boards. These signals, which are immune to noise and cable length, are then transmitted to the measurement equipment by optical fibers where they are reconverted into electrical signals for analysis in the conventional method. The electro-optic transducer is the key element; it is an integrated optic device known as a mach-zehnder interferometer. A laboratory model has been demonstrated to operate at speeds of 320 MHz.

(2) *Fault detection by spectral analysis.* This technique relates to the use of electromagnetic energy radiated by all active digital devices. This energy can be used as an indicator of their operating condition. The radiated signal can be analyzed, using Walsh functions to determine its spectral content. Since the spectrum of a normal device is different from that of a faulty one, the resulting signature can be used as a means for fault detection. A capacitive sensor is used to pick up the radiated energy. Walsh function processing is then accomplished by a microcomputer. A good/bad indication automatically results from a signature analysis in a few seconds. At the present time, a fault detection resolution of one faulty device in one thousand within a device has been obtained.

(3) *Very high speed integrated circuits (VHSIC).* The density and speed of the circuitry which will contain VHSIC in the future will certainly present new problems for logistics support. This support will concern basic measurement techniques, as well as supply support considerations. This program is still in its early stages; however, the testability aspect of the circuitry advances is already being considered in its design. In addition, it will be possible to use VHSIC itself in the test and support equipment. One can look forward to the time of a test set on a chip.

(4) *Artificial intelligence.* Artificial intelligence, in this case, is the term applied to computerized decision making that goes beyond a simple yes or no answer. The need for improved diagnostic methods stems from the fact that the resolution of unpredicted and ambiguous situations requires an expanded knowledge base capability. Normally, this knowledge is applied by the maintenance technician; but, as systems have become more complicated and skill levels have declined, this is a much more difficult task. State-of-the-art software algorithms are being treated for so-called expert systems that will utilize the accumulative data knowledge of highly qualified technicians in a manner similar to that of the human brain to diagnose unpredicted faults.

(5) *Electronic readiness centers.* The electronic readiness center will develop concepts beyond today's intermediate or depot level stations. It will include an emphasis on requirements for logistics over and above the traditional test maintenance and repair aspects. Computerized data bases and data management systems, along with advanced software techniques, will allow the storage and retrieval of large amounts of information to assist in the readiness and supportability problem. This technique will again be necessary to supplement the smaller numbers of qualified maintenance personnel who will be available to maintain future systems. To multiply the effects of the more experienced trained personnel, availability of their capabilities must be provided to the local user. This can be done either in real time or through stored techniques which will allow the local user to call them up on demand.

Summary

The potential of logistics R&D to improve the readiness of supportability of future weapon systems is almost unlimited. It must start in the basic laboratory research of our corporations and service laboratories. Next, it must move into developmental and application of prototype systems which will allow additional logistics interfaces. These developmental systems must then be tested in the field. The drawback, however, is the long time cycle involved in this process. There are, however, many existing technologies which can be applied to logistics solutions—they only need proper direction and management to materialize.

Coming in the Fall Issue

- **Impact of Rate Stabilization**
- **On-Base Level Stocking**
- **Sustainability—What To Sustain**
- **Logistics as an Interdependent Function in NATO**

MODFLEX (Modification Flexibility)

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Introduction

MODFLEX is a concept that was developed in September 1980 and has subsequently found at least partial application and consideration through the backroads of the Air Force Suggestion Program, various advisory boards, and the Carlucci initiatives. Although at the time of its origination, MODFLEX was a unique approach to logistics, design, and force flexibility problems, the basic idea was not new. Like integrated logistics support (ILS), it is a concept that has been used successfully for years in various programs on an ad hoc basis. However, the MODFLEX concept (its overall implications or expression of the general principles involved) has not been given official sanction nor considered for application to new weapon systems. The purpose of this paper is to promote understanding of MODFLEX in the hope that it will engender a comprehensive Department of Defense (DOD) policy on **design to flexibility.**

What is MODFLEX?

The term "MODFLEX" is derived from *force modification flexibility* which lies at the root of the concept. Basically, it entails designing flexibility into systems and equipment to enable rapid mission tailoring. Tailored mission capabilities are already practiced in the Air Force when only a small part of a type, model, and series (TMS) fleet has certain capacities. The aircraft are assigned to discrete organizations for tasking and simplified logistics support. On a larger scale, MODFLEX could also be applied to the programmed mission evolution of systems to meet changing threats. Finally, it has the potential to greatly enhance subsystem interchangeability and reduce certain technical quality requirements.

The MODFLEX concept originated with the realization that the number of primary weapon systems (aircraft, vehicles), which are combat ready and available for mission assignment at any given time, is necessarily reduced by scheduled programmed depot maintenance/modification, unprogrammed breakdown and repair, and assignment of systems to other missions. Under AF policies and procedures, the number of aircraft in the depots is minimal. Those in operational units in a not mission capable for maintenance (NMCM) status can, for the most part, be generated for a mission. Thus, only those that are not mission capable (NMC) for parts are limited from near-term use. This percentage is in the range of 10% to 15%; however, the AF is striving to increase parts availability so that this number can be reduced. Despite these efforts, though, an aircraft cannot be in two places at the same time. Frequently, AF weapon systems have several assigned missions. When we commit for one job, we subtract the number of aircraft available for other missions. Therefore, when combined with systems not available for near-term use due to logistics, we can significantly increase the number of aircraft which must be modified to meet special missions on short notice. The answer to this dilemma throughout DOD has been to modify enough extra weapon systems to ensure the availability of adequate systems to meet the minimum mission requirements. Undoubtedly, this is the safest method to achieve this goal. However, the question is: at what cost? MODFLEX is a common sense proposal to screen operational needs that have an extra force rationale as the primary justification for increasing the number of special mission modifications required. It also presents an alternative to costly installation of special mission equipment in weapon systems which may not be assigned to the mission.

In essence, MODFLEX means that the primary system (aircraft) is modified to accommodate easy and rapid (plug in and bolt or clamp down) installation, removal, and/or substitution of operational components (black boxes or line replaceable units (LRUs)). The primary system requires a Group "A" (wiring) modification; and the Group "B" modification equipment (black boxes, LRUs) requires modularity, portability, or, in some cases, palletization. Several caveats are necessary and appropriate here. If MODFLEX is carelessly applied, it might result in a configuration control nightmare which could inhibit logistics support and operational capability. Several specific requirements for successful MODFLEX application are covered later. We should not apply MODFLEX to all systems. Rather, **it should be considered** for all systems but **applied only** where it makes sense. MODFLEX design for force modification would permit rapid installation of special mission black boxes in combat ready aircraft. This would not only ensure that black boxes were not wasted during a crisis by being installed on non-operational aircraft but also greatly reduce the number of costly black boxes required to meet the mission requirement. The black boxes for MODFLEX could be stored at unit/base central/controlled locations for quick issue to combat ready systems.

Rapid internal component exchange is best suited to special mission capabilities; i.e., the capability is required in less than 20% of the primary system's overall missions. The MODFLEX concept should be considered similar to the current Air Force LRU replacement capability for flight line maintenance. MODFLEX, however, is really an extension of this because it would permit changing mission capability on the flight line and/or removal of unnecessary LRUs to increase system range, payload, and overall system reliability.

MODFLEX in System Acquisition (Echeloned Mission Capability)

The key to the application of MODFLEX, just as with integrated logistics support, is **early consideration** in the

system design process. Only when design flexibility and MODFLEX principles are integrated with overall system design will the concept reach its full potential.

Most of the problems we face in major systems acquisition today are centered around trying to get **too** much **too** fast at **too** great a cost. A fundamental condition of the DOD acquisition process is that it takes eight to ten years to field a new weapon system. This means that the original threat which generated the need for the system may not even exist by the time the system is deployed. It is much more likely, though, that the core mission and technology available when the design started will still be valid eight years later, but the peripheral technology and threat projection will be obsolete. This realization ought to encourage us to rethink our acquisition approach to design in terms of the flexibility required to enable a system change without costly, and in many cases avoidable, modifications. This could be accomplished using MODFLEX design. New starts for major weapon systems should have mission capabilities divided into three categories. The **first** part should have core, mission-essential capabilities required to meet known threats that will exist in ten years, to include design of the mainframe and basic system components. These core components would be required for the majority of all expected missions. The **second** category should include fairly stable technology for anticipated mission requirements (20% to 40%). The **third** category should include the long-range, volatile, or unproven technology that is most subject to change. It must also be oriented towards special missions (up to 20% of expected mission) with some potential for obsolescence if the design is not changed during system development.

By dividing system acquisition into these components, the need for design flexibility will be emphasized. Primary design is pursued along core or baseline mission needs with flexibility built in to accommodate secondary and tertiary level needs as the technologies involved matured and as the projected threat was realized. The advantage to the use of the MODFLEX approach for tertiary level design is obvious. By using a swap in/out approach, more special missions could be accommodated and obsolescent technology discarded, while still allowing the option for the application of more appropriate technology when and if it became available and its reliability was validated.

MODFLEX and Logistics

"The result I foresee is a new weapon system with core capability and growth potential, plus great mission flexibility and basic supportability."

The MODFLEX approach to new systems design will provide for the orderly growth and transition of our weapon systems as their designs mature. This should also encourage new concepts in logistics support. Some of our logistics support equipment is even more technologically advanced and complex than some weapon systems. Unfortunately, although we can start planning for logistics when we start system conceptualization, we cannot begin to finalize support equipment design until the basic weapon system design is stable. This means that finalization of support equipment design usually does not begin until the production design is completed. Hence, with support equipment we start late, sometimes four years after system design starts. It is often a concurrent operation which is generated in haste and too often with waste. This is translated into poor initial supportability. If an echeloned design approach were employed, the core design could be stabilized well in advance of the rest of the system. This means that we could be able to produce a core weapon system much earlier than an entire "guts and all" system, and we could also begin to plan for the core system logistics support equipment much sooner. By developing a new system in echelons, we could plan for logistics support in increments. The result I foresee is a new weapon system with core capability and growth potential, plus great mission flexibility and basic supportability. High risk technology could be incorporated into the systems as MODFLEX capability when it became available. Older, cheaper, and more reliable components would be retained in initial system development. Newer components that offer greater or more sophisticated capability might be incorporated at the appropriate time. Not only would this greatly reduce the initial support strain, which by its very nature is usually behind the developmental power curve, but it would also greatly reduce the initial development costs for new systems while increasing supportability and initial combat capability.

This approach to system acquisition is not an attempt to hold down or disguise true weapon system costs though stripped down purchase and out-year equipping through modification. Full disclosure to Congress of our intent to employ the echeloned acquisition approach would be required.

MODFLEX Constraints

As indicated earlier, MODFLEX design should be considered for all systems, but may in fact be beneficial in only a few cases. Several constraints apply. Care in design is required to ensure that addition and removal of subsystems would not adversely impact weapon system capability. Further, any candidates for MODFLEX should have:

a. High relative cost and/or high design risk.

b. High weight, space, or other mission degradation characteristics.

c. Special mission use.

d. Simple/fast installation and removal not unduly complicated by other MODFLEX programs or other subsystems.

e. Durable shelf life, reliability, maintainability, and minimal on-the-shelf and post-installation inspection requirements for components.

Despite these constraints, there are considerable potential benefits which can be derived from a MODFLEX design approach both in new weapon system acquisition and in modification programs. Less unnecessary/peripheral special mission equipment in each weapon system could increase:

a. Range (lower fuel consumption), speed, and payload by lowering weight.

b. Weapon system reliability and availability.

c. Subsystem and weapon system maintainability.

d. Subsystem service life and mean time between failures (MTBF).

e. Special mission capability of weapon systems.

This special equipment could also provide greater internal weapon system space for design and development considerations.

Centralized control and storage of special mission subsystems could:

a. Decrease weapon systems downtime for repair/modification of special mission components which are easily removed from the weapon system.

b. Increase subsystem availability to operational weapon systems.

c. Increase spares available to unit commander without cannibalization and provide for priority reassignment of assets during/after combat operations.

d. Provide for rapid centralized modification of subsystems (EW or safety).

e. Provide for physical security of subsystems when not in use.

f. Decrease possibility that subsystems not required for a mission would be compromised when a weapon system is deployed.

g. Provide ideal, controlled storage environment for subsystems.

MODFLEX Horizons

"Using MODFLEX in system design would permit greater role flexibility in future aircraft."

The anticipated design/technology environment of the next decade appears ideally suited to MODFLEX principles. Demands for performance and the increasingly hostile threat environment will necessitate lighter, more fuel efficient aircraft with more severe internal design constraints. This trend is exemplified by new aircraft, such as the F-18 and F-16, which have multi-mission roles but relatively less capacity to carry on-board subsystems. Using MODFLEX in system design would permit greater role flexibility in future aircraft. MODFLEX design would be particularly well suited to Naval Operations where resources and system flexibility are often limited by shipboard carrying capacity and extremely long pipelines for resupply. This was amply demonstrated in the recent Falklands Crisis. In some cases, the British were forced to modify existing systems for unexpected roles. In particular, carrier aircraft were modified for interceptor/air superiority missions using advanced American air-to-air missiles. A MODFLEX design approach, such as that used to modify commercial ships for combat support, could have facilitated such mission changes. Our Navy has already taken preliminary steps towards designing flexibility into its F-14 and F-18 aircraft. Black box exchanges may permit the ground attack F-18 to play an air attack role and vice versa. This could be critical to carrier operations and defense. Just as it was in the Falklands example, having additional carrier defense on short notice could be decisive.

MODBOX

The MODFLEX concept ought to be extended to take advantage of technological advances (microminiaturization) which could make it possible to develop flexible/universal computerized plug-in adaptor modules (MODBOXs) which could be programmed to provide near instant, embedded compatibility between the weapon system and a variety of subsystems (provide a universal Group "A" function). Such a feature will drastically reduce the cost of modification, provide for the use of commercially derived subsystems, enhance interoperability and standardization by NATO forces, and possibly even permit use of enemy subsystems in emergencies.

A system, such as the space shuttle, which has changing mission assignments could employ a MODBOX to facilitate modification and use of government furnished subsystems when possible. The shuttle will not only require standard exterior refurbishment subsequent to the mission completion, but also require internal (Class A) changes to accommodate one-time-only specific mission or scientific test equipment. Each space shuttle mission will generate new concepts/knowledge and new state-of-the-art testing. Also, it is possible that a national emergency might require the military to commandeer scheduled shuttle flights with systems designed for scientific or business requirements for military purpose. The military requirements could be so different from scientific ones that the entire internal structure would have to be changed to accommodate military subsystems. MODFLEX and preplanned, quick change military emergency systems should be designed for the shuttle to increase flexibility and decrease the conversion time to meet national emergency needs.

Summary

It is anticipated that cost will continue to be a major acquisition constraint. As indicated, MODFLEX could reduce the requirement for Group "B" subsystems significantly. Moreover, operational capability would not suffer. In the event the enemy threat or the mission of an aircraft was altered, thus increasing the requirement for a special MODFLEX mission capability, the mere acquisition of Group "B" spares would meet the need without extensive modification. Moreover, more spares in good working order would be available at central base locations (possibly stored with war reserve materiel).

Flexibility and economy of force/resources are critical principles of combat deployment. The centralized control aspect (unit level) of MODFLEX will ensure that working subsystems are assigned only to combat ready weapon systems and not to weapon systems which do not require the subsystem. It will also ensure that the greatest possible number of subsystems is in working order and available for the required missions. Readiness and combat capability could be dramatically increased if the MODFLEX concept were used in conjunction with special war use only, high reliability components. MODFLEX high reliability components (which would cost much more than regular components) could be swapped into systems when the consequences of component failure justified higher cost. We justify high reliability components for NASA because of the consequences of component failure. We can do the same thing for special war use only components.

As indicated earlier, DOD is considering MODFLEX options and design to flexibility. These concepts may allow us to maintain our quality performance standards and capitalize on technology breakthroughs at low cost with better supportability. The key is **acquisition design flexibility** for special missions. In order to achieve this as a rule rather than by fortuitous circumstance, we need a comprehensive DOD MODFLEX policy to guide design engineers and implement the required acquisition concepts and techniques.

CURRENT RESEARCH

Air Force Business Research Management Center (AFBRMC)

The AFBRMC, located at Wright-Patterson AFB, was activated in July 1973 as the Air Force focal point for the research of the system acquisition process and the development of new knowledge. Research is conducted within the USAF by students in graduate or doctoral programs and PME students, or by civilian activities such as colleges, universities, or commercial research firms, through Air Force contracts. Once the study is complete, the AFBRMC distributes the results and makes recommendations for implementation.

On-going Research Managed by the AFBRMC

AFLC Program Objective Memorandum (POM) Forecasting Accuracy
Objective: Identify data sources useful in projecting cost and lead time trends for specific commodities represented in the BP 1500 inventory; develop an approach for implementing a set of factors reflecting this information in the overall estimates; and develop a set of cost and lead time factors.
(Capt Tankersley, AFBRMC/RDCB)

Measuring Aircraft Availability Forecast Accuracy
Objective: Develop, document, and demonstrate a methodology, using existing Air Force data systems to track and compare the actual, observable aircraft availability to the theoretical aircraft availability forecast from existing spares inventories.
(1st Lt Peck, AFBRMC/RDCB)

New Approach to Air Force Provisioning
Objective: Develop a matrix to show correlation and difference between commercial provisioning (ATA Spec No. 200 and related documents) and Air Force provisioning (D220 AFLC Provisioning System, J041 Due-in Asset System, and related Air Force policy and procedures).
(1st Lt Peck, AFBRMC/RDCB)

Capital Investment: Interactions Between Tax Policy and Multi-Year Procurement
Objective: Determine how new tax code changes enhance the desirability of multi-year contracts.
(Maj Golden, AFBRMC/RDCB)

Benefit Value of the Government Industry Data Exchange Program (GIDEP) ALERT
Objective: Establish a model for evaluating a notice that states a defective part exists in the inventory. The model will establish a value for nonuse of the defective part.
(Maj Weber, AFBRMC/RDCB)

Increasing Competition for Spares Within AFLC
Objective: Identify impediments to competition and specify actions that will increase competition by examining procurement method codes (PMCs).
(Maj Weber, AFBRMC/RDCB)

Alternate Proposals: Alternate or Alternative
Objective: Summarize the policies concerning alternative proposals and suggest strategies and language to encourage alternative proposals in response to requests for proposals.
(Maj Weber, AFBRMC/RDCB)

Options Contracting in the Multi-Year Procurement Process
Objective: Model the factors which should be incorporated into optimal options contracts under different expected price profits, obsolescence probabilities, etc., and minimize discounted costs in the presence of uncertainty.
(Maj Weber, AFBRMC/RDCB)

Lease Versus Buy
Objective: Develop a position paper concerning the advantages and disadvantages of lease versus buy by identifying items that must be considered by managers in evaluating this acquisition alternative. The effect of the lease versus buy decision on the Treasury of the United States will be investigated.
(Maj Weber, AFBRMC/RDCB)

Study of Team Arrangements
Objective: Evaluate the team strategy developed by the Integrated Electronic Warfare System (INEWS) Program Office to ensure competition throughout the acquisition life cycle. The final result will be used to prepare the request for proposals for this system.
(Maj Weber, AFBRMC/RDCB)

Develop Alternate Method of Pricing Major Weapon Systems to Current Cost-Based Pricing
Objective: Evaluate the relationship that exists between cost-based pricing and productivity improvement in the defense industry. Recommend an alternate system to cost-based pricing if relationship is adversarial.
(Capt Tankersley, AFBRMC/RDCB)

Knowledge-Based Expert System for Contract Pricing
Objective: Determine the feasibility of developing a knowledge-based expert system for analyzing contractor cost proposals.
(Maj Golden, AFBRMC/RDCB)

Objective Input for Cost/Price Risk Models
Objective: Develop, categorize, and factor cost uncertainty drivers to obtain more objective input for models that establish uncertainty boundaries around a point cost or price estimate.
(Capt Tankersley, AFBRMC/RDCB)

Role and Performance of Subcontractors in the Aerospace Defense Industry
Objective: Determine the feasibility of developing a subcontractor data base for identifying the industrial base for planning.
(Maj Golden, AFBRMC/RDCB)

Manufacturing Yields and Field Failure Rates of Electronic Equipment
Objective: Develop a methodology to determine: (1) the correlation between the manufacturing yield and operational reliability of specific electronic units, (2) guidelines which specify when process yields are "in control," and (3) what manufacturing yield problems are likely to persist during the production and operation phases.
(1st Lt Peck, AFBRMC/RDCB)

Productivity Measurement Techniques
Objective: Develop a taxonomy of productivity measurement theories and techniques which can be applied at contractor plants.
(Maj Golden, AFBRMC/RDCB)

Investment Justification of Robotic Technology in Aerospace Manufacturing
Objective: Develop a methodology to measure and evaluate technical, economic, and human factor considerations in justifying capital investment of robotic technology in aerospace manufacturing.
(1st Lt Peck, AFBRMC/RDCB)

Software Data Item Development
Objective: Develop proposal evaluation criteria to aid in validating the contractor's cost and schedule for software development. Develop criteria for monitoring the performance of the contractor during the developmental program, allowing progress evaluation. Define incentives that may be used to influence effectiveness and efficiency in software development.
(Capt Tankersley, AFBRMC/RDCB)

Balancing Materiel Readiness Risks on Concurrent Weapon Systems Acquisition Programs

Objective: Develop specific guidelines and procedures for managing materiel readiness risks in concurrent Air Force programs.

(Capt Tankersley, AFBRMC/RDCB)

The Application of a Formal Uncertainty and Risk Analysis Technique in Life Cycle Cost Estimation

Objective: Develop a computer model using weapon system-oriented O&S cost data that will quantify life cycle cost variability and enable the user to assess the uncertainty of the cost estimate.

(Capt Tankersley, AFBRMC/RDCB)

AFLC Logistics Management Science Study Program

The AFLC Directorate of Management Sciences (AFLC/XRS) is responsible for developing, managing, and executing the Command's management sciences study program. The principal goal of the directorate is to support command initiatives through application of operations research methods in both organic and contract studies. It also functions as a central consultant service on a variety of logistics issues, ranging from survey data reduction to new resource requirements computation methodologies.

Organic Program

Weapon System Capability Assessments

a. *Dyna-METRIC Model.* This model will provide capability for systems managers to apply Dyna-METRIC to assess current aircraft weapon system capabilities and identify current problem items. It will also provide for testing, configuration control, documentation, and training for current and future versions of the model.

b. *Engine Meaningful Measures of Merit Methodology, EM4.* This project will study the interactions between both current serviceable stock positions and ENMCS rates and the fraction of the aircraft fleet that is up (having serviceable installed engines) throughout the surge and sustain wartime periods.

c. *Jet Engine Management Simulator, JEMS.* This project has adapted JEMS for both modular and non-modular engines (MJEMS, TJEMS) and continues as a testbed for developing improvements in input/output and for testing logic changes. The model predicts daily aircraft readiness due to engine support along with selected other line replaceable units for any given scenario and program for aircraft and is used by both AFLC and MAC to examine aircraft readiness based on engine support.

d. *JEMS Applications.* This will assist in the implementation of JEMS for specific engine applications, including the TF39 and F100. These applications address a wide range of logistics management policies and capability assessments, including maximum utilization rate analyses, JEIM resource balancing and sizing in order to reach an aircraft readiness objective, and development of engine meaningful measures of merit methodology.

e. *In-Theater Repair Operation (INTRO).* The purpose of this study is to develop an approach for identifying those items where an in-theater depot level repair capability will result in high payoffs in increased aircraft weapon system availability.

f. *WARS Research Model Development.* The objective of this project is to develop an in-house Air Force computer based system which will permit research on improving the capabilities of WARS and allow the use of WARS techniques and outputs in future logistics studies.

g. *Utilization of Aircraft Availability Goals in D041.* In an effort to improve the D041 requirements computation, HQ USAF, in conjunction with the AFLC, decided to utilize aircraft availability goals in computing peacetime stock levels for Budget Program 1500 recoverable items. The purpose of this project is to help AFLC/LOR develop and document a mathematical approach to accomplish this objective.

h. *EOQ METRIC.* This is a preliminary study designed to demonstrate the effect on aircraft availability of using a method proposed by Dr. J. Muckstadt, an Air Force Reserve officer, for computing *consumable* item requirements. Results will be compared with those provided by current Air Force methods. The proposed procedure utilizes aircraft availability goals in the requirements determination process.

i. *WARS Feasibility Testing.* The Wartime Assessment and Requirements Simulation (WARS) Model represents a new concept in requirements determination for Budget Program 1500 recoverable aircraft spares. The WARS Model development was contracted to determine if the developed concepts can be incorporated successfully into an operational model. XRS is providing assistance in this effort as part of the on-site Air Force Technical Team.

j. *Capability Assessments in D041.* AFLC/XRS, in conjunction with AFLC/LOR, developed an assessment version of the Logistics Management Institute (LMI) availability model. The objective of this project is to develop the necessary documentation for incorporating this aircraft weapon system capability assessment technique into the D041 requirements computation.

k. *Mod-METRIC Enhancements.* Mod-METRIC is an initial provisioning model which is currently being used to compute requirements for modular type engines. The objective of this project is to augment the Mod-METRIC requirements computation to include cannibalization options, item readiness measures, and procurement limitations.

l. *LMI Availability Model Studies.* In recent years, the LMI availability model has been used by the USAF to assist them in their evaluation of Air Force spares programs and budgets. The AFLC is now also using this model. The objectives of this project are (1) to improve the model's capabilities, (2) to evaluate alternative methods for establishing parameter values, (3) to test parameter sensitivity, and (4) to determine and analyze differences in item buy requirements and aircraft availability between the current requirements computation and the LMI method.

m. *Computer Models for Logistics Studies.* The LMI availability model, the VSL simulation model, and the Dyna-METRIC and MOD-METRIC models are methods which are currently being used extensively by AFLC personnel to perform studies to improve our logistics support capability. This project provides for maintenance of these models and continual education of AFLC personnel on how to use them, their capabilities, and interpretation of results.

FY 83 Contract Studies Program

Recoverable Item Requirement and Capability Assessment Methodology for Non-Weapon System Spares (D041)

Objective: Develop a methodology to compute the requirements that will minimize the peacetime investment subject to a required total system effectiveness in wartime for non-weapon system spares in the AF Recoverables Item Replenishment Requirement Computation System (D041).

(James Brannock, AUTOVON 787-4139)

Standard Methodology for Assessing Strategic and Tactical Missile Spares Capability

Objective: Determine the most meaningful method to measure the relationship between BP25 and BP26 missiles spares funding levels and missile operational capability. Find a more direct relationship between spares and performance measures.

(Raymond Jackson, AUTOVON 787-4139)

Aircrew Training Devices Support-Contractor Logistics Support Study

Objective: Provide an independent analysis of present and alternative support concepts for logistics support of ATDs in the 1980s on a worldwide basis. The Air Force is proposing to convert from in-house to contractor support of ATDs. This conversion requires careful evaluation to define the most mission and cost-effective support concept for ATDs and ensure timely and orderly transition with minimum cost and mission impact.

(Joseph Loch, AUTOVON 787-6751)

Forecasting Requirements for Equipment Items

Objective: Develop a more accurate and timely method of forecasting requirements for equipment items. Develop capability assessment methodology that relates secondary item spares funding to weapon system availability. Ensure that equipment requirements are computed in a way logically consistent with secondary items. This includes adequate forecasts for buy, budget, and POM purposes, as well as replacement, repair, and support levels for critical items.

(Douglas Fleser, AUTOVON 787-4139)

Design Study for an Automated Preventive Maintenance Scheduling and Control System

Objective: Prepare a design and cost study for the purpose of developing a computer system useful for scheduling a tracking preventive maintenance associated with mechanized materiel-handling systems and ancillary warehousing equipment.

(Miles Johnson, AUTOVON 633-6553)

Requirements Data Bank (RDB) Project Assessment

Objective: Review and critique AFLC's approach to accomplishing the AF RDB Project. The contractor's assessment will include approaches in procurement, source selection, automated data system concept and development, and functional structure. Risks will be identified and solutions proposed that will minimize the risks.

(Harold Harris, AUTOVON 787-2906)

JADMAG

Objective: Continue support of the tri-service effort. The contractor will review the services policies in determining equipment buys as related to surge requirements and provide a discussion/comparison of service policies.

(Evelyn Bebout, AUTOVON 288-4187)

Project Warrior

Project Warrior is a concept fomulated to create an environment where our people can learn from the warfighting lessons of the past and use that knowledge to better prepare for the future.

Logistics Warrior

Logistics Warrior is the contribution of your journal to help create that environment. Your suggestions are solicited.

LOGISTICS WARRIORS: Women's Uniforms - World War II

"Despite a somewhat masculine appearance, the basic design of the WAAC uniform was not all that bad considering how little precedent there was to go on. The end product, however, could not have been worse from any standpoint—cut, fit, color, tailoring, material, quality.

To begin with, the supply depot had failed to make graded designers' models in the various women's sizes, so the manufacturers had to develop their own. The contracts were let to manufacturers of men's wear because the women's garment manufacturers could not make them at the price the Army would pay. As might be expected, the end product looked and fit as though it had been intended for men rather than for women. The jackets were heavily padded in the shoulders and flat chested, and the skirts were too narrow for women's hips. Moreover, the materials used were generally unsatisfactory for women's clothes, and the colors of the skirts and jackets rarely matched. The general cut of the uniform plus the low-heeled, laced oxfords, men's shirts, and neckties combined to create a generally unfeminine appearance that did not enhance the WAAC's public image.

The supply system was a bureaucratic nightmare: the Army was unable to issue one complete set of authorized uniform items to its first group of female recruits. During the first winter, half the women in some training centers graduated without uniforms. One center opened in Massachusetts in March 1943 with no uniforms at all. Thousands of women had to endure training, often in the snow, wearing the same single civilian outfit they were allowed to bring from home. The Army had simply failed to let the contracts in time, or in sufficient quantities, to meet the recruit accession schedules. Moreover, the supply system got fouled up by a requirement to disperse the stocks on hand to five different training centers to support the unprogrammed expansion of WAAC recruiting. In one instance, a supply depot shipped clothing items needed at one training center to another center and vice versa, and the depot commander refused to exchange them because it would confuse his records. Even when supplies arrived, the depots soon ran out of small sizes. Said one dismayed trainee, 'It looks like those clothes were intended for a race of giants.' An enormous amount of time and effort was expended cutting size 18L to fit size 10S.

By the time the supply began to catch up with the demand in mid-1943, the bottom had fallen out of the recruiting program, and the Army was stuck with an enormous surplus of uniforms. By then the gross deficiencies in quality and fit were evident, but, because of the surplus of stocks, new improved uniforms could not be procured. The women were stuck with them. Not until the Army realized the negative effect the sorry state of uniforms was having on morale and recruiting was the decision made to get rid of the surplus and introduce a decent uniform."

"The Navy avoided the Army's problems by going to a well-known women's fashion designer, Mainbocher of New York, for the original design and then contracting with the women's fashion industry to make the uniforms."

"Another major controversy had to do with hose. Since men did not have to wear them, there was no precedent to fall back upon, and civilian custom required that women wear hose. Decisions on the matter were dictated to a large extent by wartime shortages. Japanese silk was no longer available, and the new nylon had immediately disappeared from lingerie and hosiery shelves, to reappear as parachutes. The only material left for stockings was cotton—either heavy weight or the finer lisle—and rayon. The Army had settled for the cotton in tan shades, which soon turned a dingy greenish yellow; but the Navy would not hear of cotton.

McAfee termed the ensuing conflict, which was resolved by a high-level decision, as the 'battle of the black stockings.' The Chief of Naval Operations, after visiting Canada and being impressed with the Women's Royal Naval Service members in black stockings, insisted that the WAVES should wear them, even though they strongly objected. American women did not wear black hose except in the evening hours, and the only ones available were sheer rayon—very fragile and inappropriate for daytime wear. But the CNO would not be dissuaded; not even his wife or his daughter could convince him. Only when he was told by a man during a dinner party that the dye used for black stockings was also needed in the manufacture of gunpowder and that it was in short supply did he back down. Because he did not want to jeopardize the war effort, Navy women could wear the tan rayon hose they preferred."

From: *Women in the Military* by Major General Jeanne Holm, USAF (Ret).

LOGISTICS WARRIORS: Technology Transfer and Military Supremacy

"A host of other examples could be cited to document the full dimensions of the losses that the United States and its allies are sustaining in the quiet war for technological supremacy. Military and industrial espionage have been the concomitants of international rivalry and conflict throughout the modern era. Yet, the verdict can be ventured that at no previous time in history has one nation been able to prey so deeply and systematically upon the fruits of its adversaries' genius and labor. And probably at no previous time has an alliance of threatened societies been so lax in turning over to the threatening power the technological wherewithal of their own security.

There is no assured means of preventing the Soviet Union from obtaining advanced Western technology through espionage, although this Administration has made a significant effort in such areas as tightening border security and increasing the awareness of law enforcement agencies and manufacturers of militarily relevant equipment. There is little hope also of substantially reducing the amount of technology the Soviet Union can acquire through open Western publications and academic exchanges. The potential penalties in infringements upon freedoms are too high.

Yet, it is possible to control unwarranted legal sales. Here, the principal factor is the profit motive—or, to put it more precisely, greed. It is essential that the United States and its Western allies, through CoCom and other means, put a stop to the sale of military and dual-use technology to the Soviet Union and its allies and surrogates. A major effort is needed to persuade the U.S. business community and the American public, as well as our allies, that the potential consequences of these transfers are intolerable."

From: "Technology and the Quiet War," *Strategic Review* (Winter 1983), by Richard Perle.

LOGISTICS WARRIORS: Fighter Logisticians

It is said that Ghingis Khan looked for men of endurance, ones who were sullen, fatalistic, phlegmatic, and callous—ones who suffer without complaint and kill without pity. Each of these delightful creatures wore, besides tunics and trousers, a long, loose raw silk undergarment—any arrow that hit usually carried the silk into the wound making removal easy and the wound more likely to heal. The Mongol crossbow was marvelous—a pull of 100-160 pounds (English longbows had 75-pound pull), made from layers of horn and sinew on a waterproof wooden frame. Velocity increased using the Mongolian thumb lock—a stone ring worn on the right thumb which was used to draw back the bow string for faster releases. It worked! He had arrows for every purpose: long-, short-ranged, three-foot armor piercing ones, whistling arrows, incendiary arrows, and arrows tipped with tiny grenades. He worked his bow in the saddle, aiming between paces of his horse so pounding hooves would not deflect his aim.

The horse he rode was also magnificent—almost prehistoric, 16 hands tall, battle trained for three years. On the march, each man had three mounts. Mongol horses were better cared for than any other horses in history. A dead trooper was always buried with his favorite horse.

Men learned precision and maneuvers as teenagers. It was law for teenage boys to be instructed in archery and horsemanship. But the most important law was the one that prescribed the great hunt, a peacetime campaign held at the start of winter which lasted till spring. In a great line, the entire army moved forward, pushing all game before it for hundreds of miles. Any trooper who let an animal escape past him had failed and both he and his commanding officer were punished. Wild boar and wolf packs violently attacked the troopers. After many miles, a circle would be formed, racing deer were run after, tigers were killed with bare hands, other animals were more conventionally slaughtered for food, and the Khan usually released the others. For 800 years, the Mongol system worked because great fighters were great logisticians.

Condensed from: *The Devil's Horsemen* by James Chambers.

Item of Interest

Deployable Mobility Execution System (DMES)

Any logistician who has ever been involved in aircraft load planning knows it is a thankless, time-consuming job. Acceptable load plans require anywhere from 30 minutes to over an hour for an experienced load planner. The importance of being able to produce timely, accurate, and realistic load plans has drawn a lot of high level attention in recent months.

Help is on the way. The Deployable Mobility Execution System (DMES), developed at the Air Force Logistics Management Center by Lt Kirk Yost and Capt Jeffrey Cameron, is a prototype deployable aircraft load planning system designed for use on a microcomputer. DMES currently load-plans C-130E, C-141B, and C-5A aircraft. It emphasizes interactive graphics which keep the load planner "in the loop." This capability lets the planner use his expertise to improve loads and to make real-time updates in cargo weights and dimensions as they occur. This real-time update capability is a critical feature of DMES. The dynamic state of a deployment and the many differences in cargo characteristics make timely changes in load plans nearly impossible when using other methods or systems.

During the recent Team Spirit '83 exercise, DMES was given the acid test: a full-blown deployment by the Marine Corps from Iwakuni AB, Japan, to Yechon AB, Korea. Although this exercise was a rather ambitious first test for a prototype system, DMES passed with spectacular results.

The test team, consisting of Lt Yost, SMSgt Randy Lee of HQ MAC, and TSgt Buddy Liston of 22AF, worked on a noninterference basis with the USMC. The Marines had already completed their load plans by hand, and the MAC airlift flow was based on those plans. The DMES test was to parallel the Marine efforts, using the actual deployment lists.

When they arrived at Iwakuni, the DMES team put together their deployment lists from scratch. Since they had none of the data ahead of time and were unfamiliar with Marine equipment, they had to measure it by hand and build up a deployment list for use by DMES. Weighing and measuring the equipment, developing the deployment list, and accomplishing the actual load plans for the C-141B flow took a total of 8½ hours. The actual load planning itself took TSgt Liston, a C-5A loadmaster with only two days' training on DMES, 3½ hours. In addition, the USMC had planned for a possible C-130 flow with the same equipment. SMSgt Lee, also a C-5A loadmaster with only three days' training on DMES, finished the load plans in about 5½ hours.

The significance of the test results is readily apparent. For the C-141B flow, the USMC used the standard "stubby pencil" method to load 134 end items and 497 passengers, or 536 short tons, on 21 aircraft and took 140 man-hours. TSgt Liston loaded the same equipment on only 18 aircraft in 3½ hours. For the C-130 flow, the Marines planned for 480 short tons on 47 aircraft and took 60 man-hours. SMSgt Lee planned for the same equipment in 5½ hours and required only 37 aircraft.

Using MAC airlift costs, the short trip from Iwakuni to Yechon had a potential cost savings of approximately $34,000 for the C-141B flow and $72,000 for the C-130 flow. These figures do not include the impressive savings in man-hours which could have been realized.

In today's atmosphere of limited funding and airlift shortages, the Air Force—indeed the DOD—cannot afford to pass up the substantial capability of DMES. The spectacular results of Team Spirit '83 show DMES to be a fast dollar payback system whose effect on combat readiness, sortie generation, and manpower savings will significantly contribute to our overall war-fighting capability.

The Logistics Burden

Logisticians are a sad, embittered race of men, very much in demand in war, who sink resentfully into obscurity in peace.

They deal only with facts, but must work for men who traffic in theories. They emerge during war because war is very much fact.

They disappear in peace, because in peace, war is mostly theory.

The people who trade in theories and who employ logisticians in war and ignore them in peace are Generals.

Logisticians hate Generals.

Generals are a happily blessed race who radiate confidence and power. They feed only on ambrosia and drink only nectar.

In peace they stride along confidently and can invade a world simply by sweeping their hands grandly over a map, pointing their fingers decisively up terrain corridors, and blocking defiles and obstacles with the sides of their arms.

In war they must stride more slowly, because each General has a logistician riding on his back and he knows that, at any moment, the logistician may lean forward and whisper: "No, you can't do that!"

Generals fear logisticians in war, and in peace, Generals try to forget logisticians.

Romping along beside Generals are Strategists and Tacticians.

Logisticians despise Strategists and Tacticians.

Strategists and Tacticians do not know about logisticians until they grow up to be Generals—which they usually do—although sometimes Generals will discipline errant Strategists and Tacticians by telling them about logisticians.

This sometimes gives Strategists and Tacticians nightmares, but deep down in their heart they do not really believe the stories—especially if the General lets them have an occasional drink of his nectar.

Sometimes a logistician gets to be a General.

In such a case he must associate with Generals whom he hates. He has a retinue of Strategists and Tacticians whom he despises, and on his back is a logistician whom he fears.

That is why logisticians who become Generals are a fearsome and frustrated group who wish they were anywhere else, beat their wives, get ulcers and cannot eat their ambrosia.

Thanks to Admiral Isaac Campbell Kidd, US Navy (Ret), first quoted in *Naval War College Review* (Jan-Feb 1983)